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POWER

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The Review of the Year

WE LIVE at a tremendous rate. Each succeeding year the aids to human faculties and facilities increase. New horizons open out and the pace accelerates.

The worker, engrossed with the multiplying demands upon his time and attention, swept along with the tide of current events and submerged by them, is apt to fail to sense the direction and rate of progress even in related fields.

It is an excellent habit, conducive to orderly thinking, intelligent direction of effort and the wise use of time, to review nightly the events of the day in preparation for and anticipation of the morrow.

In like manner it is interesting and profitable, at this recommencement season, to pause for a moment and take account of stock; to glance backward over the year that has just passed and see what its trends and accomplishments have been, what it has produced that will mark it for distinction when the history of the art comes to be written in the wider perspective of more distant time, what its indications are for present progress.

For these purposes and with these thoughts in mind *Power* presents in this issue its Annual Review of the Year, marshaling its outstanding happenings and achievements as they affect the production, distribution and application of power, in the hope of collectively "Turning the accomplishment of many years into an hour-glass" to measure the progression of the industry.

INDUSTRY NEEDS POWER'S PROGRAM IN 1929

LAST September *Power* brought forward a program of seven parts which, if adopted and carried through in the power plants of the country, would result in reducing the cost of power entering into the goods and services used by all people. Since then that program has appeared on the editorial page of each issue of the paper, and it appears at the end of this column.

It is not supposed that, in stressing this program, new facts are being brought to the attention of power engineers. But, in the midst of the infinite detail necessary to the supervision of power services, the engineer often temporarily loses sight of one or other of these important aids to power cost reduction. The program, and the articles on one part of it or another that appear each week in *Power,* help to keep the matter continually in mind and, by showing how others have made savings, help each engineer with his own cost problems.

And it is necessary that it should be kept in mind. For 1929, as in 1928, the continuation of industrial prosperity depends on keeping costs at a minimum. The power engineer, to be successful, must do his full share of this work. So, again, in 1929,

POWER *Stands for . . .*

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**

POWER was founded in November, 1884, by Emerson P. Harris and H. M. Swetland. With it was incorporated a paper called "Steam," which had been started by N. Hawkins in Chicago two years earlier.

A few years later ownership passed to H. M. Swetland and James H. McGraw; then to John A. Hill; and with the consolidation of the Hill Publishing Company and the McGraw Publishing Company in 1917, it became the property of the McGraw-Hill Publishing Company.

Robert Grimshaw was the first editor of "Power." Subsequent editors for short periods were George L. Fowler, A. D. Risteen and Franklin VanWinkle. F. R. Low became editor in 1888, which position he still holds.

The present editorial staff of "Power" is F. R. Low, editor; P. W. Swain, managing editor; G. L. Montgomery, A. D. Blake, L. H. Morrison, F. A. Annett, associate editors; Thomas Wilson, western editor; and F. L. Beers, A. L. Cole, R. B. Purdy and D. O. Woodbury, assistant editors.

Retrospection

IT HAS become the custom in all lines to make this time an occasion for taking stock of progress during the year. Accomplishments of a single year are usually difficult to appraise. The time is too short and the picture too close to permit proper evaluation. But when one looks back over the last ten years, a better perspective is gained. In the power field it has been a decade unparalleled.

At the end of 1918 we were still operating with maximum steam pressures under three hundred pounds. Although one steam turbine unit of around sixty thousand kilowatts was in service and another was on order, it was generally predicted that thirty thousand kilowatts represented the practical economic limit for some years to come. Superpower was being talked of, but, with perhaps a single exception, there were no systems that would warrant much larger units. When turbine sizes did begin to increase, there was a period during which boiler capacities lagged.

Now, within the comparatively short period of ten years, the country is practically covered with a network of interconnected systems. One station of a million kilowatts ultimate capacity is now nearing completion; others of over half that size are operating; a number of one-hundred-and-sixty-thousand-kilowatt turbines have been installed and one of over two hundred thousand kilowatts will soon be running. Single boilers are being built to turn out eight hundred thousand pounds of steam per hour. In the realm of steam pressures there has ceased to be any limit up to the critical.

But along with this progress toward bigness has come economic improvement which has permitted over double the electricity production at only a slight increase in fuel. The year just closed, while contributing its share of outstanding things, has been one of experimentation and development along less spectacular lines to meet the demands of the rapid advances noted. In Europe much attention was given to certain fundamental studies in-

tended to place the systems of power supply on a sound economic basis adequate to meet industrial growth.

From the business point of view 1928 was especially good in the power-plant field. While present indications point to a continuation of these conditions for the early part of 1929 at least, it would be too much to expect orders to increase at the same rate above present levels.

Need for Research in the Power Field

ENGINEERING is a profession of progress. Research, or the creation of new knowledge, is the foundation of engineering progress. The success of modern industries and utilities depends upon the extension of knowledge gained through research. A Wall Street publication recently declared that "The research progress of a company is a guide to the investment value of its securities."

In a recent report of the Engineering Foundation, which is an instrumentality of the national engineering societies for research, the following statements are made: "Civilization must choose between research and going back. Appreciation of research grows among engineers, industrialists and business men. The choice is between research and retrogression."

In the earlier days of the development of industry much dependence could be placed upon the individual inventor, but with the increased size and complexity of modern industry it is not practical to wait upon chance discoveries by men of genius. Leaders of industry are convinced that research laboratories must be used to acquire new and exact knowledge of facts, to develop new products, and to lower manufacturing costs. Research is of value in improving old industries and in building up new ones. The telephone, the incandescent light, the automobile, steel manufacture, and many other wonders of our civilization are the products of research.

So much has been accomplished through invention that many people are of the opinion that everything worth while has been discovered and that the engineer is concerned only with the application of existing knowledge. This idea is erroneous, as the engineering profession is confronted today with many problems of the most serious nature which can be solved only if the best engineering brains of the country are constantly at work on research. To mention a few of these problems:

In power engineering there is insufficient knowledge to burn all grades of fuels economically, or to construct prime movers which will make the best use of our natural resources. Annual losses of millions of dollars to American industry have been shown to exist through fatigue of materials, and it is but recently that this important problem has been made the subject of systematic study. Metallurgical researches must be conducted in order to discover suitable metals for higher temperatures. Much research is needed in coal mining methods as well as in oil and gas field practice in order that the cost of fuel to the public may be decreased and wastes reduced to a minimum.

While much progress has been made in the power industry during recent times, the opportunities for greater things in the future are unlimited if more attention is paid to research.

Dr. A. A. Potter, Dean of the Schools of Engineering and Director of the Engineering Experiment Station at Purdue University, will keep the readers of *Power* in touch with the progress of research through a special column which will appear in the first issue of every month. In this issue he discusses the Research Agencies in the United States.

Water Power Can Still Compete With Steam

POWER produced in hydro-electric plants must compete on an economic basis with steam-plant generation. Many engineers believe that changed conditions have put water power at a disadvantage with steam. In some localities this may be true, but in general water power can still compete with steam, if not encumbered by other than economic factors. Political and other obstructions are frequently greater obstacles to water-power development than the economic relation between it and steam.

Considered from an economic point of view, conditions have not changed as much in favor of the steam plant as certain facts might indicate. An average of about three pounds of coal was burned per kilowatt-hour produced by steam central stations in this country during 1920. Last year this relation was slightly over one and three-quarter pounds, a reduction of forty-one per cent, which is equivalent to seventy per cent more kilowatt-hours from the same amount of coal.

Although the efficiency of hydro-electric generating units has not increased so fast as steam-electric and will not be much higher than it is now, the efficiency of these plants shows a marked increase. In 1920 hydro-electric central stations in this country produced about twenty-three hundred kilowatt-hours per installed horsepower. The 1928 figure for this relation was thirty-four hundred and fifty, which shows that the output has increased about fifty per cent. This increase is not so great as the improved efficiency of steam-electric plants. In this period, however, the output per unit of steam-electric generating capacity installed increased about twelve per cent only.

All the increase in output per unit of capacity installed in hydro plants has not been due to improved efficiency. Increased precipitation no doubt accounts for a considerable part. There is evidence that the valley of a one-hundred and fifty year precipitation cycle has been passed. If this be true, an average increase in rainfall may be expected in the future, which will favor water-power development. These and other factors add to the economic value of hydro projects, so that they can compete with steam.

LARGER UNITS ... PLANT EXTENSIONS ... REFINEMENTS

...FEATURE

NINETEEN twenty-eight witnessed a steady advance in power plant practice, with few things of a spectacular nature, but many refinements to meet present exacting demands. The number of new stations announced or completed was relatively small, although many additions were made to the equipment of existing stations in the utility field. Among industrial power plants rehabilitation continued, greater attention being given to power and steam supply in the process industries, with a view to effecting better heat balance. To this end there was more extensive employment of higher steam pressure, high-pressure turbines exhausting to process, bleeder turbines, and the combination of purchased and privately generated power.

Building was active in the larger cities, but the new buildings, very largely, are being served by central-station power and in many cases by central-station steam as well. They do involve, however, a variety of power services.

Work was started on two more plants in the1200-1400 lb. class, namely, the Deepwater Station near Wilmington and the Holland Station at Holland, N. J. The former is being built jointly for the American Gas & Electric Company, and the United Gas Improvement Company. Steam will be generated at 1,350 lb., 725 deg. and will supply three turbine-generators, two 53,000-kw. cross-compound condensing units, taking steam over the whole range from boiler to condenser; the third, a 12,500-kw. high-pressure unit, will exhaust at 200 lb. to furnish process steam to one of the plants of the DuPont company.

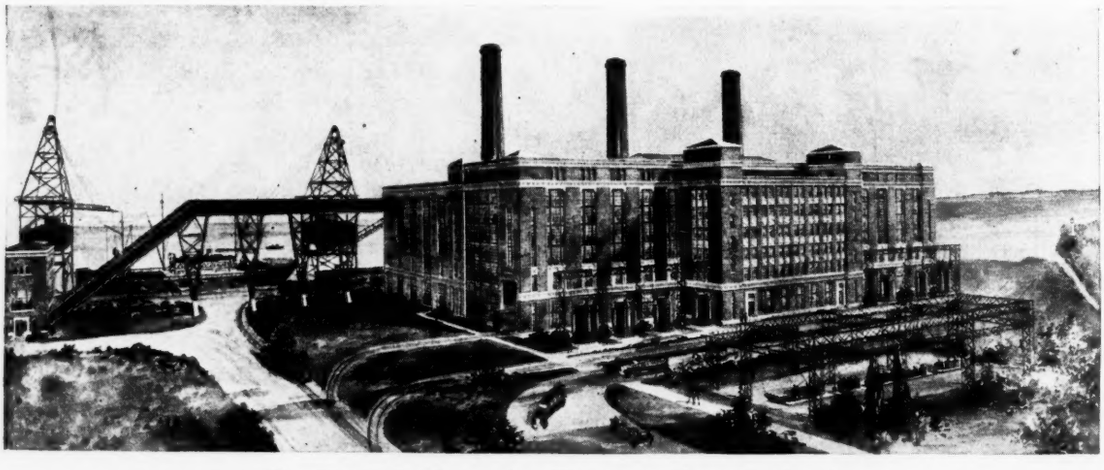
At the Holland Station steam will be generated at around 1,400 lb. and will supply 55,000-kw. cross-compound turbines, employing reheat at 400 lb., 750 deg. The initial installation calls for two boilers and one turbine-generator, but additional units will be put in later.

These two central stations are the first to be built in this country as complete high-pressure plants. Edgar, Lakeside and North East (Kansas City) stations, it will be recalled, employ separate high-pressure units exhausting to the station steam mains at 350 to 400 lb. Both of the new stations will burn pulverized coal.

During the year two more 1,400-lb. boilers and a 12,500-kw. turbine were ordered for Edgar Station, making in all five boilers and three turbines in the high-pressure section of this station. A second high-pressure turbine generator of 7,700 kw. was installed at Lakeside.

One of the most interesting announcements of the year was the decision to employ a boiler pressure of 1,800 lb. in the new power plant of the Philip Carey Manufacturing Company, near Cincinnati. This will be the highest steam pressure ever used in America, and it is especially interesting because it is being undertaken by an industrial establishment. The main generating units will be triple-expansion reciprocating engines of German make, taking steam at 1,400 lb., 800 deg. and exhausting around 60 lb. to process.

The growing use of relatively high pressures in industrial plants is exemplified by a plant now being erected at the Waldorf Paper Products Company in St. Paul, where two 650-lb., 1,200-sq.ft. boilers, fired by unit pul-



Deepwater Station as it will appear when completed

One of the first complete 1,200-lb. steam-electric power stations. Owned by the American Gas & Electric Company and the United Gas Improvement Company, and located at Deepwater, New Jersey. Designed and constructed by Stevens & Wood, Inc., New York City.

IN DESIGN . . . MORE HIGH-PRESSURE PLANTS

PROGRESS . . . IN 1928

verizers, will operate normally at 450 per cent rating. A number of industrial plants have adopted 400 pounds.

Employment of high steam pressures in industrial plants with the prime mover exhausting to process, in the opinion of some engineers, augurs well for the return of the steam engine as a competitor of the turbine for this character of service. This view is backed by the higher Rankine efficiency of the engine in this high pressure range.

Another interesting installation will be a 10,000-kw. unit which one of the power companies is about to install to operate at 1,100 deg. at the boiler and 1,000 deg. at the turbine. The pressure will be conservative, and temperature will be controlled by a separately fired superheater. This unit will be somewhat of an experimental nature although operating on commercial load as part of a large station. It will be operating this year.

An announcement that attracted attention several months ago was the intention to install a private plant comprising unit pulverizers and uniflow engines in the "New Yorker," which, when completed, will be largest hotel in New York.

Of the plants that went into operation during the year, the Powerton Station of the Super-Power Company of Illinois, at Pekin, Ill., is perhaps the most notable. This is a 600-lb. station with an initial capacity of one 50,000-kw. unit. A second unit will go in later.

The trend toward large capacities in steam power plant practice was typified by the installation of several turbine-generator units of around 160,000 kw., a considerable number from 75,000 kw. up, and the placing of an order for three boilers rated at 800,000 lb. of steam per hour.

Construction on the State Line Station is progressing and it will go into operation some time during 1929. This station, it will be recalled, will ultimately contain five 208,000-kw. turbine units.

Delray No. 3 of the Detroit Edison Company is also nearing completion. Initially, this will contain two 50,000-kw. turbine-generators operating at 400 lb., 700 deg. The decision as between pulverized coal and stokers was finally made in favor of the latter largely because the plant's situation did not permit of ready disposal of the fine ash from pulverized coal, whereas there is always a demand in Detroit for stoker cinders.

Another installation around which interest centers is the 10,000-kw. mercury boiler and turbine which have recently been completed at the South Meadow Station of the Hartford Electric Light Company. A smaller unit of somewhat different design was put on commercial load at the Dutch Point Station of the same company several years ago.

Here it may be of interest to mention that diphenyl, as a substitute for mercury in the production of steam, is under experiment by three different companies.

Among the smaller plants one worthy of mention is the 15,000-kw. Avon Park Station of the Florida Public Service Company, in which the boilers and turbine are placed in the same room. This arrangement, together with centralized control and all auxiliaries placed within view of the operator, permits one-man operation. Fuel oil is burned under the boilers. Another plant of about the same initial capacity that was started and completed during the year was the Lake Pauline Station of the West Texas Utilities Company. Excavation was started on Feb. 13, 1928, and on Sept. 10, 1928, the station went into operation, establishing what is probably a construction record for a 15,000-kw. central station.

An outstanding installation in the industrial field that went into service during the year was the Hopewell, Va., plant of the Air Nitrates Corporation. This is a 425-lb. plant employing 1,200-hp. steam engines driving compressors and exhausting to low-pressure turbines. There are also high-pressure turbines, both condensing and exhausting to process.

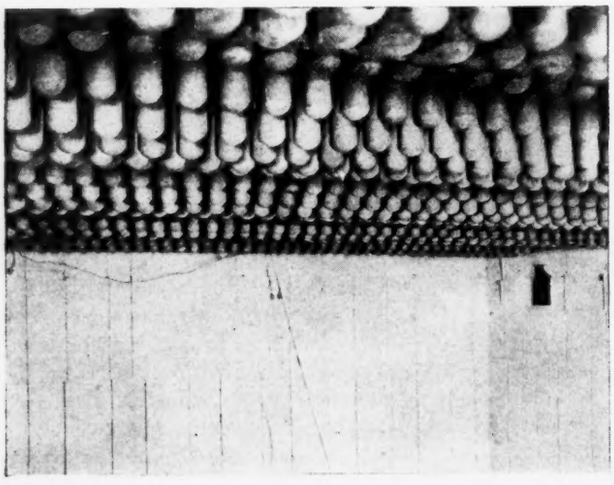
In the rehabilitation program of power services being carried out at the Packard Motor Car Company in Detroit, a unique arrangement is effected whereby a bleeder turbine supplies steam at 85 lb. to process and the condenser of which is the heater for the factory hot-water heating system. Power is generated only to the extent that it is available as a byproduct from heating and process steam. When the turbine is not operating, process steam is supplied from evaporators which return good condensate to the boilers.

Another automobile plant in Detroit, that of the Chevrolet Motor Company, has effected large savings through the installation of mixed-pressure turbines taking steam from the hammers.

The Pennsylvania Salt Manufacturing Company, at Wyandotte, Mich., installed two 3,000-kw. and one 6,250-kw. turbines, the latter equipped with an automatic bleeder control. Steam bled from the turbine is used for the evaporation of caustic soda solution and for plant

heating. The new arrangement has effected a saving of 45 per cent in total steam over that used by their old reciprocating engine plant.

An unusually large number of big turbine-generators was added to existing stations during the year. Some are already in service and others are about to be placed in operation. They include a 165,000-kw. cross-compound, three-cylinder machine at Philo; a 165,000 cross-compound, two-cylinder turbine for Hell Gate; a 160,000 cross-compound two-cylinder unit for the same station; a 160,000 tandem-compound with double-flow pressure element for East River Station; a 110,000-kw., two-cylinder, cross-compound at Hudson Avenue; a 104,000-kw., three-cylinder, cross-compound at Crawford Avenue; and a 94,000-kw. at Long Beach, Calif. The largest single-cylinder machine is a 75,000-kw., 1,800 r.p.m. unit built for Cahokia, and the largest 25-cycle,



Looking into the furnace of the mercury boiler at South Meadow Station
Note the tubes ends

single-cylinder machine has recently been placed in operation at the Charles R. Huntley Station, Buffalo. The 208,000 three-cylinder machine for State Line Station is nearing completion. Ultimate plans call for five such units.

Worthy of special note is the 160,000-kw. tandem machine being installed at East River Station, New York, inasmuch as the single generator has two separate windings in alternate slots, each having a capacity of 80,000-kw. These windings are not connected electrically, but tie in with adjacent bus sections. By this arrangement half the load could be obtained from one of the windings should the other be out of commission. On the steam end the high-pressure element has eighteen stages and the low-pressure six. The operating conditions are 375 lb. pressure, 700 deg. total temperature and three-point extraction.

From the foregoing it would appear that the present limits are about 75,000 kw. for single-cylinder machines, 160,000 kw. for tandem-compound and 208,000 for cross-compound units. None of the large turbines mentioned is intended to operate at more than 600 lb. or 750 deg. F. In the opinion of one builder, 700 lb. is the practical limit for single-cylinder units and for all pressures over this multiple cylinder units, with reheating, are recommended. Furthermore, 775-deg. temperature seems about the limit so far sanctioned for large single-cylinder machines.

A number of cases of blade failures during the year led to further vibration studies resulting in altered blade dimensions and methods of attachment, and improvements in finishing so as to avoid sharp edges and tool marks. Advances were also made in the process of working stainless steel blading.

Another subject that received considerable attention was that of starting. It is well known that when a spindle has been brought to rest after operation, distortion occurs during cooling because the bottom portion tends to cool more rapidly than the upper. Several cases of serious rubbing occurred upon starting up, and in two or three instances sprung spindles resulted. In order to permit a turbine to be put into operation in a minimum period, means must be provided for cooling all parts of the spindle uniformly. One device for accomplishing this result consists of a hydraulic barring gear by which the operator can turn the spindle 180 deg. at stated intervals. A high-pressure oil pump keeps the bearing floating during this operation. A second method which has proved satisfactory for large machines, is the use of a 10-hp. motor which is thrown into gear with the spindle when the latter in slowing down has reached 25 to 30 r.p.m. This motor continues to rotate the spindle during the shutdown period.

Other turbine improvements during the year cover changes in steam chest and steam inlet piping and governing devices.

The number of turbines sold for industrial plant use showed a decided increase during the year.

Condenser Practice

The advent of very large turbines has been accompanied by multiple condenser units. The largest single-shell condenser now in operation has about 85,000 sq.ft. of surface. This serves the 110,000-kw. turbine at Hudson Avenue Station. The two 160,000-kw. turbines previously mentioned will each have two two-pass condensers of over 62,000-sq.ft. each. The 94,000-kw. unit at Long Beach has four vertical condensers.

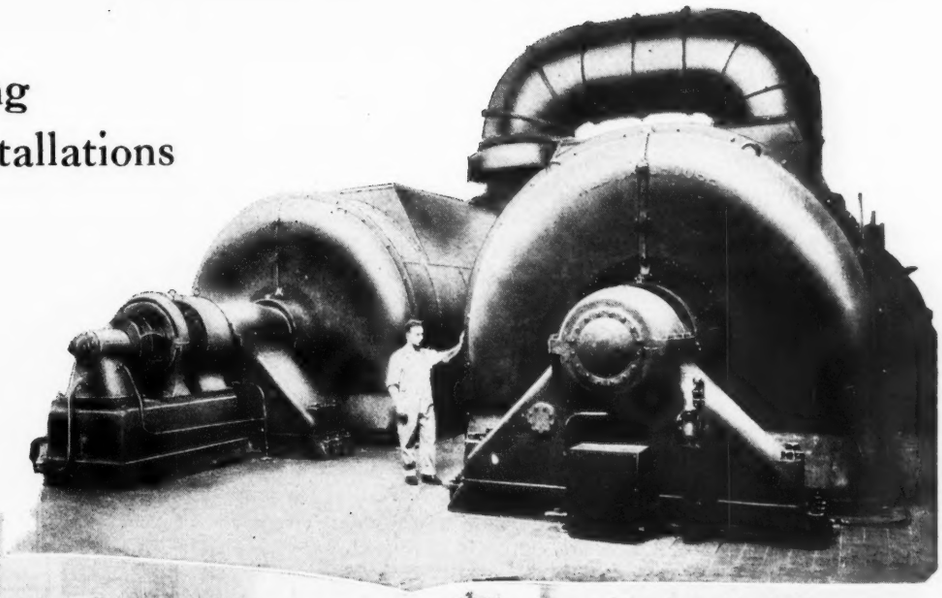
A check-up by the Prime Movers Committee of condensers in 65 stations showed 41 per cent to be single-pass. Of these nearly two-thirds served turbines of 50,000-kw. and over. The amount of surface per kilowatt was considerably greater for the two-pass than for the single-pass condensers for turbines under 30,000-kw. and only slightly greater for the large machines. The average ratio of condensing surface per kilowatt for single-pass condensers is given as 0.82 and for multi-pass condensers, 1.22.

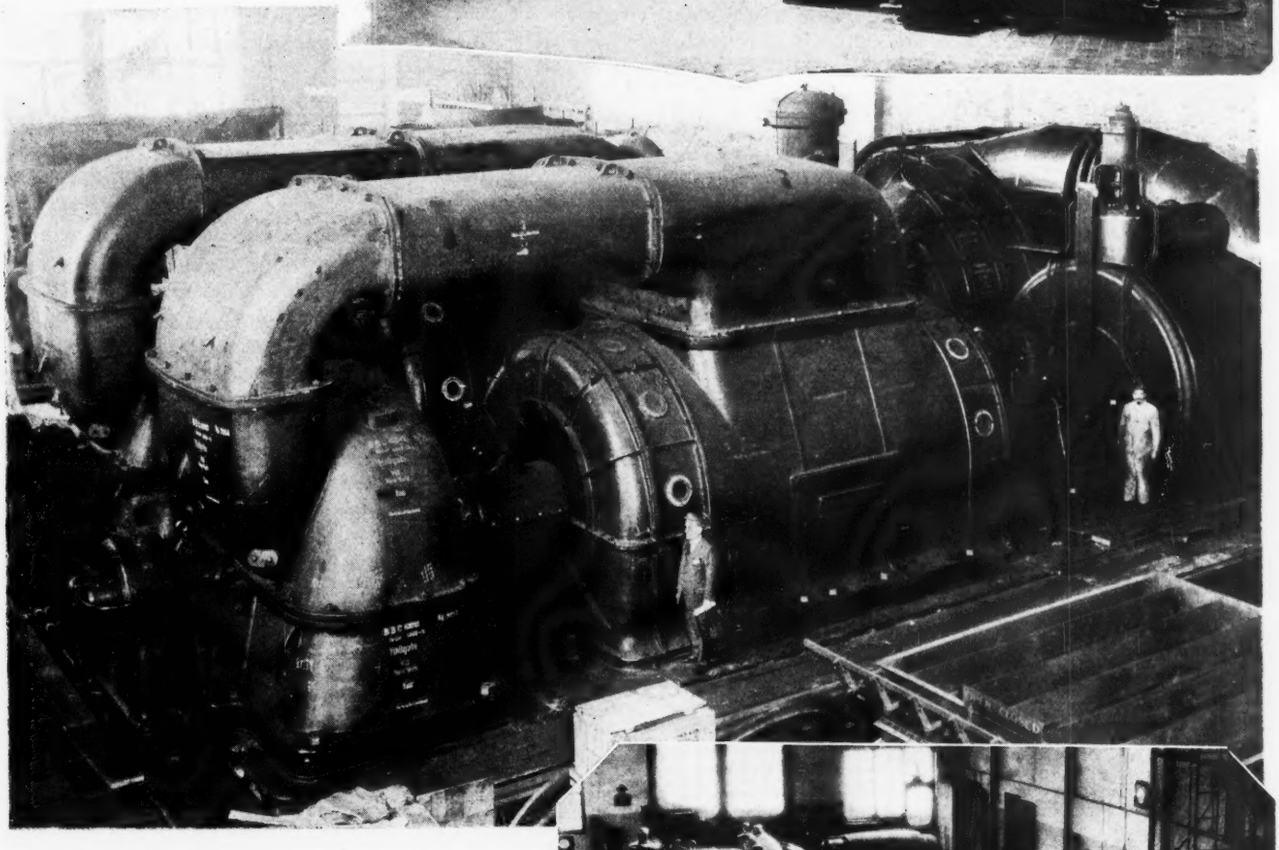
Trend Toward Larger Boiler Capacities

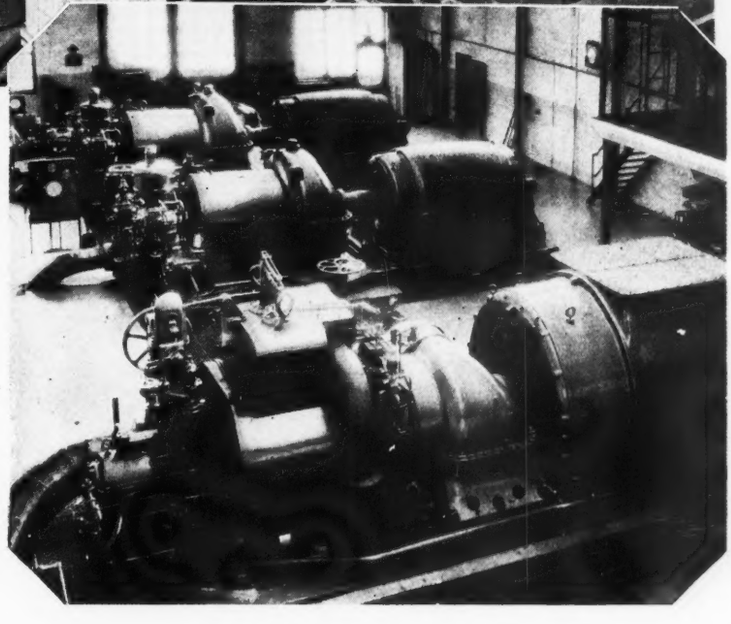
There is a marked trend toward larger boiler units in both central stations and industrial plants. Orders for central-station boilers of 300,000 to 400,000 lb. of steam per hour are no longer unusual, and recently an order was placed for three boilers, each rated at 800,000 lb. of steam per hour. These will go into the East River Station in New York. For industrial plant service boilers of 10,000 to 12,000 sq.ft. are now common.

Redistribution of heating surface in boiler units is also apparent with the extensive use of economizers and air preheaters. For instance, the first high-pressure boiler installed at Edgar Station in 1925 had 15,732 sq.ft. of heating surface and was rated at 143,000 lb. of steam per hour. The last two, ordered in 1928, will have less than one-half of this boiler heating surface, yet will carry a rating of 250,000 lb. of steam per hour. They

Some Outstanding Turbine Installations







Top—Cross-compound 110,000-kw. Westinghouse turbine-generator lately placed in service at Hudson Avenue Station, Brooklyn

Middle—American Brown Boveri unit of 160,000 kw. at Hell Gate Station, New York. The view is from the fan end with the high- and low-pressure elements at the extreme right. The large pipes are ducts for ventilating air

Bottom—Turbine room at Pennsylvania Salt Mfg. Company, Wyandotte, Mich.

will, however, have more economizer and air preheater surface.

Employment of water walls is steadily increasing for both stokers and pulverized coal. It has been estimated that about 40 per cent of the water-tube boilers now sold are equipped with water walls—plain or covered with refractories or metal blocks. With large boilers the trend is toward water walls on all sides. Sustained heat releases of 12,000 to 15,000 B.t.u. per cubic foot of furnace volume per hour is attainable with air-cooled refractory walls, and from 25,000 to 50,000 with water-cooled walls. Experience with the fin type of wall has shown that short fins are preferable to the long fin in order to avoid burning.

One company making a vertical boiler has brought out a combination slag screen and water-cooled bridge wall in which a row of tubes is placed in front of the boiler heating surface proper.

Automatic combustion control is being more extensively used, not only among central stations but in many of the larger industrial power plants.

Refinements in Pulverized-Coal Equipment

While the total capacity of central systems installed in large power plants still greatly exceeds that accounted for by the unit system, the latter continues to show a steady growth, especially as applied to large boiler units. In industrial plants it is several times that of the central system. Developments during the year have pointed to greater refinements in both systems and in burners, based on closer studies of the influence of pulverization fineness and flame reactions. There has also been a trend toward larger mills.

Some simplifications of the central system have been apparent, as well as adaptation to smaller space requirements. Although some separately fired driers have been installed, there is wider use of preheated air for drying the coal within the mills.

Horizontal short-flame burners are replacing the vertical long-flame type and turbulent burners are gaining favor. These are of both the tangential and the flame-impingement types.

There has been wider appreciation of the fact that all coals do not pulverize equally well, and, further, that a given pulverizer may not be suited to all kinds of coal. This has led to modifications in design to meet requirements and more intelligent selection of equipment. Carbon loss in flue dust is being studied. Factors that enter into this loss are high rates of combustion, improper mixing and coarse pulverization.

Dust from driers, mills and bin vents is still a perplexing problem in many localities, and various means have been adopted to handle it, including the use of two cyclone separators in series or water sprays in series with a cyclone separator. Exhauster fans are being installed on the clean side of the collector to minimize fan blade abrasion. In some places the disposal of the fine stack ash presents a problem, and in one case where slagging furnaces are used, it is planned to return this ash to the furnace well.

There are three large plants burning pulverized anthracite exclusively, two more are successfully burning pulverized Texas lignite and another Colorado lignite.

Success with the four early well-type furnaces at the Charles R. Huntley Station in Buffalo has led to the addition of four more of this type, in which the slag is tapped off daily in molten state, shattered by water jets and sluiced to a fill. About 30 per cent of the ash in the coal is thus disposed of. An over-all efficiency of 85 per cent has been attained at ratings up to 550 per cent. In the last boilers special brick for the bottom of the well has been dispensed with, and the slag is allowed to accumulate and protect the firebrick. A second plant to put in slagging furnaces is the Toronto station, near Youngstown, where two of this type have lately been installed. Ashes having fusing temperatures of 2,300 to 2,700 deg. F. are successfully handled in this manner.

Pulverized Coal in Marine Field

In the marine field the Shipping Board vessel "Mercer" has been in regular transatlantic service without interruption for over a year. Minor difficulties were encountered, principally in securing satisfactory distribution to the three furnaces of the Scotch boilers, but that problem appears to have been solved by rearrangement of the piping and the use of a pneumatic distributor. All things considered, the cost of operation with pulverized coal (14,000 B.t.u. at $5 per ton) seems to be about on a par with oil at a dollar a barrel. The low price of boiler oil, effective the first of the year, will temporarily wipe out the margin in favor of pulverized coal for marine use, but how long this situation will last is uncertain. For vessels in the Pacific and Gulf port trade oil has a decided advantage.

The "Mercer" is now operating with ball tube mills, but other types have been undergoing test at the Philadelphia Navy Yard, notably small individual high-speed pulverizers, combined with burners, for each furnace, and designed so as to provide maximum flexibility of operation. These will soon be put into a Shipping Board vessel.

Present experience with pulverized coal for marine use indicates that considerably finer pulverization is required than would be necessary with large refractory-lined furnaces; high turbulence and short flame travel are essential with the Scotch boiler, and uniform distribution to the several furnaces is most important.

The Canadian collier "Lingan" has been running on the St. Lawrence with pulverized coal for several months, and the English steamer "Stuartstar," partly equipped to burn pulverized coal, has operated between England and Buenos Aires. The latter vessel employs high-speed mills. The British Admiralty is also reported to be carrying on some investigations along this line.

Stoker Improvements Meet Competition

Changes in stoker design initiated two or three years ago to meet the demands for increased capacities with high narrow boilers, preheated air, and greater flexibility, have been carried to greater refinement during the year. The increased stoker length has brought about a combination of underfeed and overfeed sections in the underfeed stoker, and there is noticeable a more general use of over-fire admission of air through the front wall with both types of stoker. Moreover, steel has replaced cast iron for many parts in order to provide greater strength. These and other refinements have enabled stokers to hold their own in competition with pulverized coal.

The employment of preheated air has been responsible for new designs of tuyeres and greater clearances to provide for expansion. Although at least one manufacturer claims operation of 700 deg. preheat possible with his stoker, it is noticeable that in practice the preheat seldom exceeds 400 to 500 deg. F. In many cases it is less, owing to the tendency to place an economizer in series with the preheater.

Greater attention has been paid to better control of the air supply throughout the fuel bed, to which purpose refinements have been effected in zoning. In some instances air is also introduced at the clinker pit. Better control of the clinker rolls, water-cooled refractory-lined pits and more flexible stoker drives are other points warranting mention.

As to rates of driving, average practice seems to be about 50 lb. of coal per square foot of grate with underfeed stokers, although maximum sustained rates as high as 78 lb. are reported.

In the marine field one Lake steamer has operated with stoker-fired boilers and one of the large boiler manufacturers is developing a chain-grate stoker for marine use.

Foremost of all matters that were accorded special attention during the year was the subject of "fuels." More time in conference and discussion and a larger number of technical papers were presented on various phases of the subject than on any considerable number of other topics combined. There were three large meetings during the fall, devoted exclusively to fuels; namely, the Second National Fuels Meeting of the A.S.M.E. at Cleveland, the London Fuels Conference (a Sectional Meeting of the World Power Conference), and the Second International Conference on Bituminous Coals at Pittsburgh. At the last-mentioned meeting 110 papers were presented.

Low-Temperature Carbonization

In the past year low-temperature carbonization of coal has reached the stage of commercial exploitation—not as an independent manufacturing process, but as an adjunct of power and manufactured gas developments. The 50-ton unit of the Carbocite process installed at Philo station of the American Gas & Electric Company operated with sufficient success during 1928 to warrant the addition of another 50-ton unit to the plant. The K.S.G. plant of the International Coal Carbonization Company, a subsidiary of International Combustion Engineering Company, which is to be operated in conjunction with the gas plant of the Public Service Gas & Electric Company, in New Brunswick, N. J., reached completion just at the close of the year. The interest in these and other low-temperature ventures is general on the part of public-utility companies, and development along similar lines may be looked for during 1929.

Metals and Refractories

No great forward strides were made during 1928 in the application of metals in power service, although progress in the field of high temperatures and high pressures continues. Carbon steels, because of their cheapness and known qualities, are still used for most work, even though it is common knowledge that alloy steels have more desirable qualities under severe service conditions.

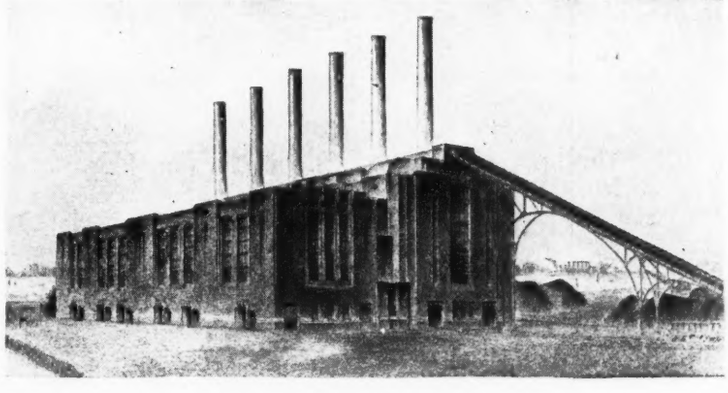
The reasons for this lag in the change from carbon to alloy steels for power generating equipment are the great number of possible alloys and the lack of knowledge as to which of these has the optimum properties. The progress realized during the year consisted mostly of a tremendous amount of fundamental research into the behavior of a wide range of alloys at elevated temperature and under stress. This work, carried out by the Bureau of Standards, many universities and a number of large manufacturers of equipment, has not yet reached the stage of general agreement as to which alloy should be used to meet a given set of conditions. It has, however, resulted in the compiling of a great mass of data on the subject which, when correlated with further research, promises to make available alloys that will permit the safe use of higher temperatures and pressures than have yet been applied.

Definite progress in the application of refractories in the boiler furnace seems to wait upon the outcome of the present situation as between these materials and the all-metal furnace walls. Practice today sanctions three general classes of furnace wall: All-refractory, refractory and water-cooled, and metal and water-cooled. In spite of the success and increased use of the all-metal construction, particularly where pulverized fuel firing is used, there is every reason to look forward to an increase rather than a decrease in the quantity of refractories used.

When the attention of engineers is again turned to these materials, they will find that 1928 has brought research advances. Fundamental researches have been made by the Geophysical Laboratory and the Bureau of Standards as to the properties of various refractory materials, and research carried out under the auspices of the American Society of Mechanical Engineers has determined much concerning refractory performance. Silicon-carbide refractories have given successful results in more extensive installations than those formerly tried. Most important, new refractory materials of superior properties, such as diasport and mullite, have developed in use to the point where they are available for application to boiler furnace conditions.

In the field of steam table research progress was reported by the Massachusetts Institute of Technology and the Bureau of Standards. There is now available a revised chart for steam up to the critical point. This has been prepared by J. H. Keenan and is based on the Harvard Joule-Thomson effect supplemented by Knoblauch's findings for the lower and medium pressures and upon the work of Doctors Keys and Smith, of M.I.T., for the high-pressure range.

A review of the year would be incomplete without mentioning two large-scale mergers of operating companies, namely, acquisition of the Philadelphia Electric Company by the United Gas Improvement Company and the merger of the Brooklyn Edison Company with the New York Edison Company and the United Electric Light & Power Company into the Consolidated Gas Company System of New York City.



From architect's drawing of Delray No. 3

WATER-POWER PLANTS

Take Bigger Share of the Load

TWO features mark last year's developments in water power. These are the number of important plants put into service and the great increase in power produced by hydro-electric plants. Although there has been a large increase in plant capacity in service, an equal capacity in new projects has not been started.

In the United States a slowing down in water-power developments is apparent. This can be attributed to political interference, discriminative taxes and improvements in steam-station designs that make these plants serious competitors with water-power developments. Many of the more favorably situated water-power sites have been developed. The droughts of a few years ago have had an effect to create an idea that water power is not dependable.

Notwithstanding these conditions, power produced in hydro-electric plants established a new record in 1928. Not only was there a marked increase in the kilowatt-hours produced in these plants, but the ratio between power produced in hydro and steam plants was materially increased in favor of water power. During eight years, 1920 to 1927 inclusive, of the power generated in central stations in the United States, an average of 35.6 per cent was produced in hydro-electric plants. For the last twelve months this percentage has increased to about 43. The highest previous figure was in 1927, when hydro plants accounted for 37.2 per cent of the total central-station generation. These figures are all the more significant on account of about 10 per cent increase in the total power generated in central stations during 1928 over 1927. This brings the power generated by hydro close to 36 billion kilowatt-hours. The total power generated in central stations in 1920 was 39½ billion kilowatt-hours. Therefore the power produced last year in hydro-electric central stations was about 91.5 per cent of the total generated by steam and hydro eight years ago.

At the beginning of 1920 there was installed about 6,000,000 hp. of hydro-electric capacity in central stations, and this produced about 14 billion kilowatt-hours. At the beginning of last year there was about 10,500,000 hp. installed in central stations. These figures indicate that in 1920 about 2,333 kw.-hr. was produced per installed horsepower of hydro capacity, while in 1928 this figure increased to 3,420 kw.-hr., or an average increase of about 46 per cent in the effective use of water power.

This increase can be accounted for in several ways: First, the increased capacity of hydro plants; a second cause is the interconnection of power systems, which allows a better use of the available water for power generation; an increase in the operating efficiency of hydro-electric plants, an ever-increasing number of plants are being operated to obtain the best efficiency.

Previous to 1920 little attention was given to testing waterwheels in place. Even when tests were made, small use was made of this information for operating the plant. Since 1920, in the United States and Canada, about 175 waterwheels have been tested by the Gibson pressure-time method and 120 by Prof. C. M. Allen, using his salt-velocity method. In addition, many tests have been made by the latter method by power companies on the Pacific Coast.

These tests have a double significance. Most of them have been made for the purpose of determining the efficiency of the wheels in their setting and for working up a schedule by which the machine can be operated to obtain the highest plant efficiency. In some high-head plants venturi tubes have been installed in the penstocks to give continuous records, on meters at the switchboard, of the water going to the wheels. In other plants a change in section of the penstock has been used to operate venturi meters and thus obtain a continuous record of the water flow to the wheels. Where these devices are not available, the waterwheel gate positions have been calibrated by the use of input-output curves obtained by test, so that a daily check on the efficiency of the plant may be had.

This increased interest in the efficiency of these plants has led to a more careful check on the conservation of water and the factors that affect the over-all efficiency of

Installed capacity and kilowatt-hours generated in hydro-electric plants show a large increase last year. About 43 per cent of the power generated in central stations, was hydro-electric. These plants indicate a large increase in efficiency. In 1920 there were produced 2,333 kw.-hr. per installed horsepower, whereas in 1928 this relation was about 3,420 kilowatt-hours. Reasons for this increase are given and water-power development in the United States and Canada are compared.

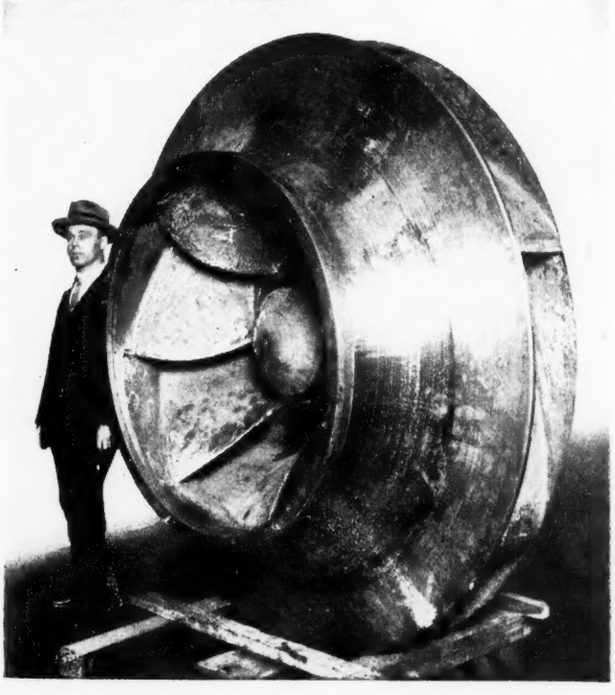
the plant. An indication of what is being done toward water conservation is the cutoff valves installed at the lower ends of the penstocks of the Conowingo plant. These valves are 27 ft. diameter, but are practically tight against leakage when they are closed. There has been an awakening to the fact that water has a monetary value the same as coal has, and letting water get by the plant without producing kilowatt-hours is on a par with dumping unburned coal into the ashpit. In other words, hydro-plant operators are becoming water conscious and are giving careful study to its conservation.

The efficiency of the wheels is being more carefully checked, and in many plants when it falls below a given value the unit is overhauled and put in normal condition again.

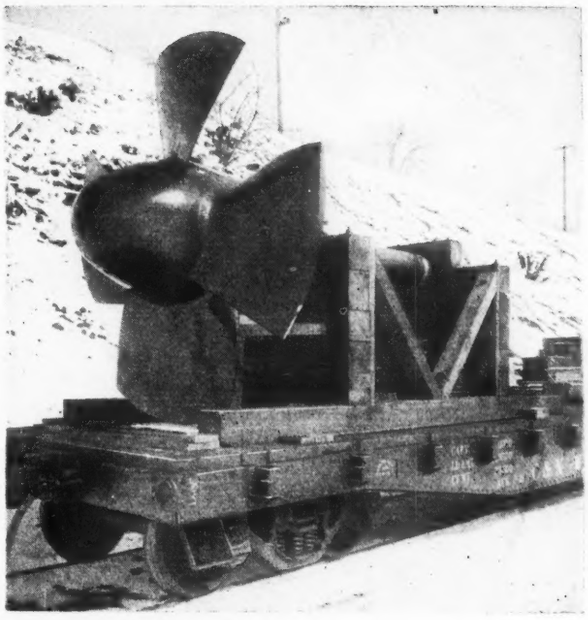
One of the largest factors is probably increased rainfall. This, however, is a somewhat difficult factor to evaluate, since high water at one plant may allow operating at full capacity and at another it may shut the plant down on account of high tailwater. Then, at other plants the amount of water that can be used is limited by treaty or other restrictions and is not affected by rainfall. Taking the country as a whole, increased precipitation results in increased power generation from hydro-electric plants. Authorities are of the opinion that the valley of a 150-year cycle in rainfall has been passed. If this be true, and there seems to be good reason to believe so, then a gradually increasing precipitation may be expected as time goes on.

These conditions tending to increase the output of hydro plants, combined with improvements in design that reduce the cost of construction, should in the near future react to cause an improved trend in water-power development in the United States.

Last year there were some outstanding plants put into operation in this country. One of these was the Conowingo development of the Philadelphia Electric Company, on the Susquehanna River. In this plant there are



Runner for one of the two 8,100-hp. pumps in the Rocky River hydro plant of the Connecticut Light & Power Company



One of six 5,000-hp. propeller-type waterwheels, with adjustable blades, installed in the Chippewa Falls plant of the Northern States Power Company, Wisconsin

installed seven 54,000-hp. units, which operate under a 90-ft. head. These units are the largest in dimensions of any constructed in this country.

For high-head plants another record was established in the Big Creek 2A development of the Southern California Edison Company. Two units have been put into service, each rated at 56,000 hp. and operating under a 2,418-ft. head. Each unit consists of two overhung impulse wheels mounted on the same shaft with a 45,000-kva. generator.

Another interesting station is the Norwood Plant of the Carolina Power & Light Company, which operates under a head of 70 ft. In this plant there are three units totaling 88,000 hp. The generators on these units are of the outdoor type and are the largest machines of this design so far installed.

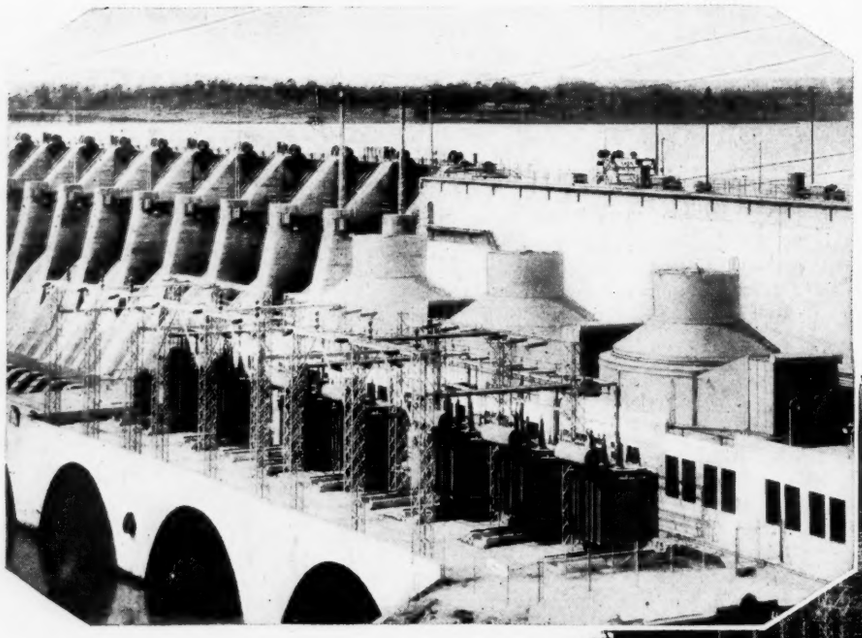
During the last year the Rocky River development of the Connecticut Light & Power Company went into service. This plant is the first in this country to operate on pumped water. It contains one 33,000-hp. vertical-shaft waterwheel and generator and two 8,100-hp. pumps to operate under 240 ft. head.

For a record low-head plant, that built at the Falls of the Ohio, by the Louisville Hydro-Electric, Louisville, Ky., was completed the early part of 1928. This plant has eight propeller-type units to operate under heads ranging from 37 to 10 ft. At the higher head the wheels have a capacity of 13,500 horsepower each.

These stations and others that have gone into operation give the year 1928 a particular significance in water-power development.

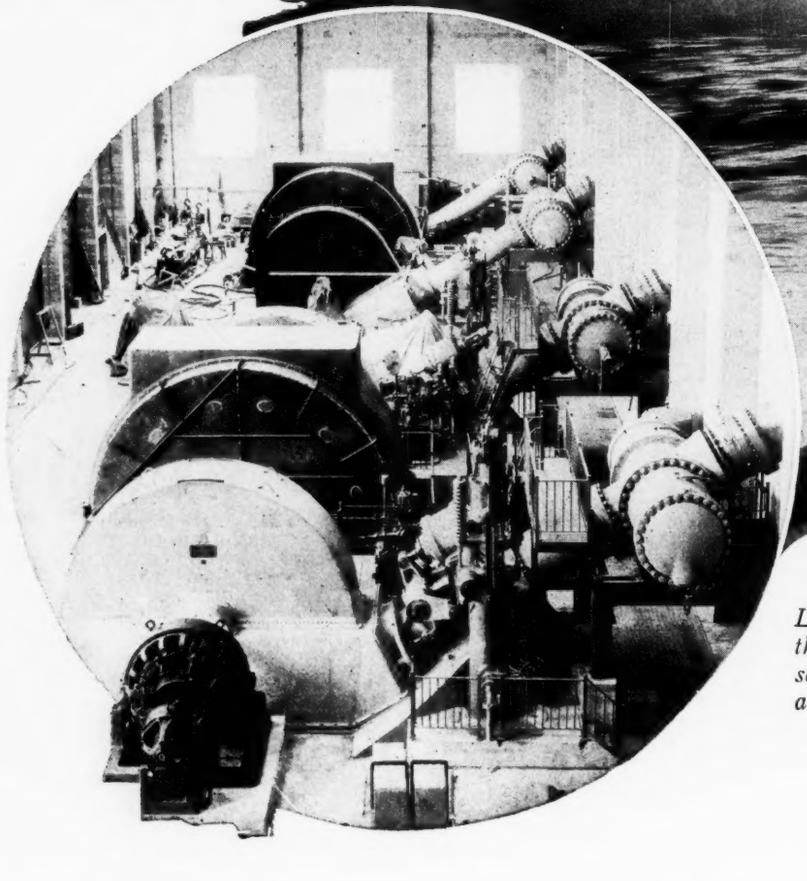
In Canada, water-power development continues to be active. Not only did a large number of projects go into service, but others were started that maintain the rate of development. In Canada they have ironed out their political differences on water power more satisfactorily than in the United States. Cheap fuel is not a competitor, and there are many sites that can be developed at low cost. These factors, combined with a rapid industrial expansion, bid fair for future Canadian water-power business.

Typical Hydro



Below—Connecticut Light & Power Company's Rocky River plant contains one 42,000-hp. generating unit and two 8,100-hp. pumps. This plant operates on pumped storage under a 240-ft. head

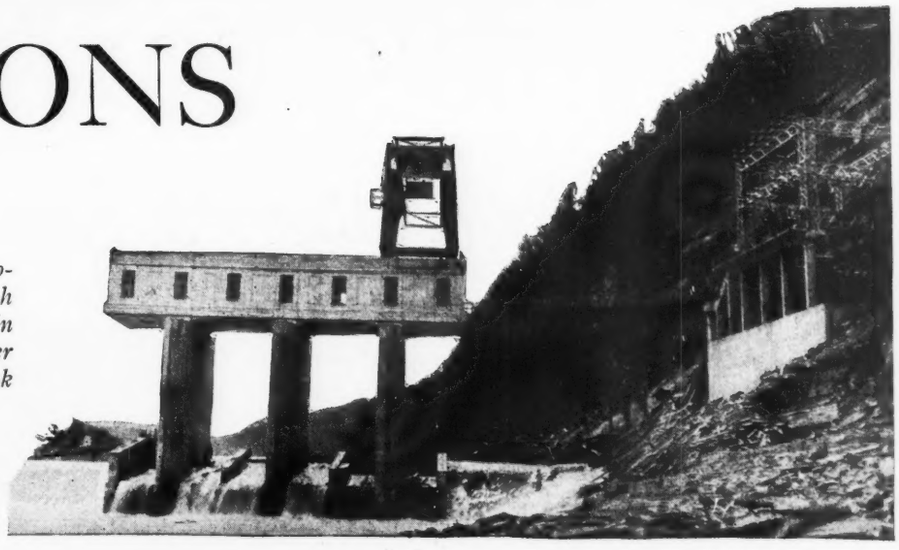
Above—Norwood plant, Carolina Power & Light Company, has installed generating capacity of 62,000 kw. in three units. Generators are of the outdoor type

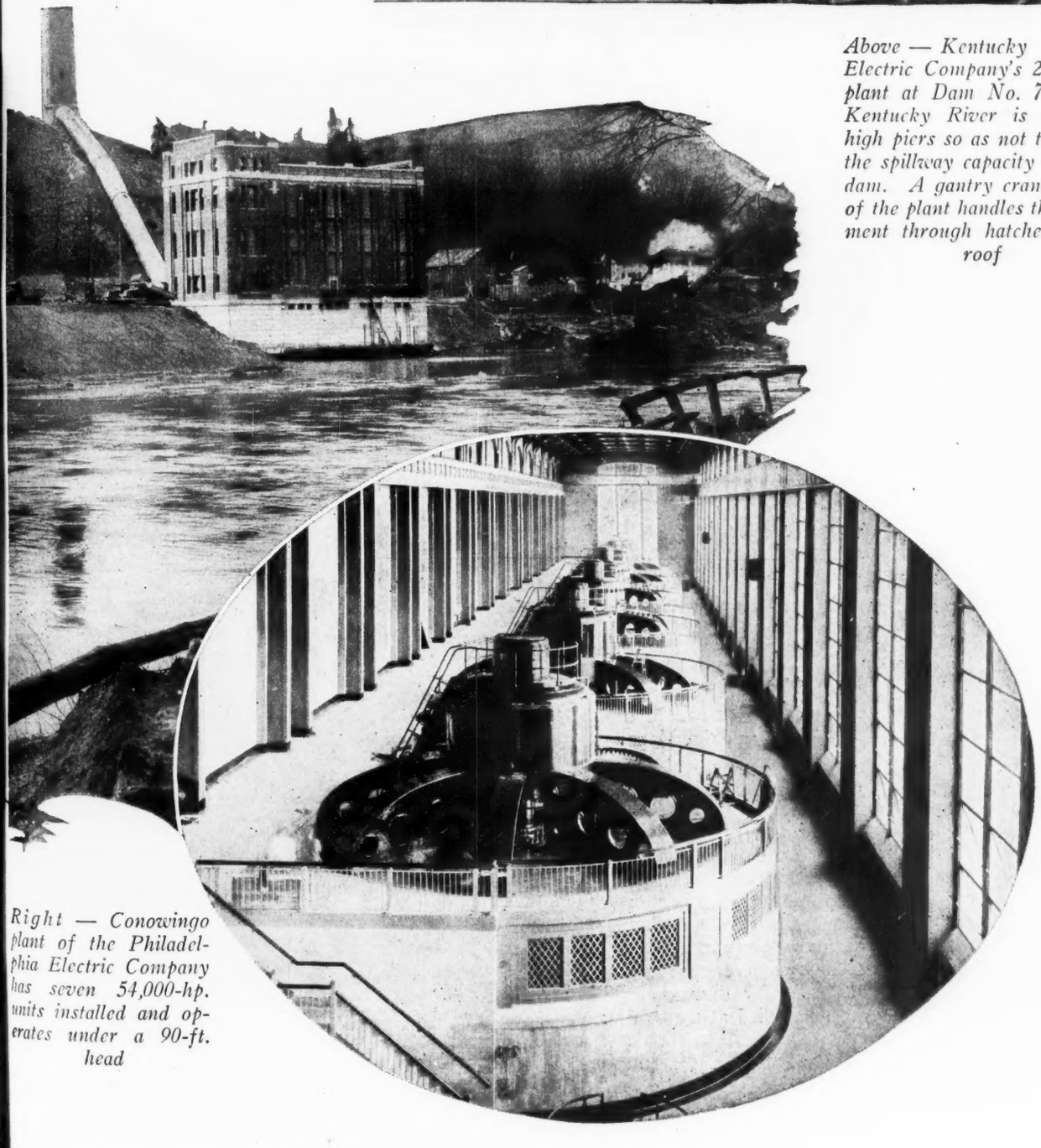


Left—Big Creek 2A plant of the Southern California Edison Company operates under a head of 2,418 ft. and contains two 56,000-hp. units

STATIONS

The water is pumped with excess hydro-electric power during periods of high water and off-peak steam power in periods of low water. Rocky River plant will be used chiefly on the peak loads of the system





Above — Kentucky Hydro-Electric Company's 2,000-kw. plant at Dam No. 7 on the Kentucky River is built on high piers so as not to reduce the spillway capacity over the dam. A gantry crane on top of the plant handles the equipment through hatches in the roof

Right — Conowingo plant of the Philadelphia Electric Company has seven 54,000-hp. units installed and operates under a 90-ft. head

ELECTRIC EQUIPMENT
Improvements Include

a single generating unit rated at 160,000 kw.; synchronous condensers designed for outdoor operation and cooled with hydrogen gas; and transformers of unprecedented size

RAPID growth overshadows other features of the electrical industry. This applies both to the use of electrical power and to the size of the generating equipment. Since the beginning of 1920 the output of central stations in this country has more than doubled. In this period the size of single generating units has increased from 45,000 to 160,000 kw., or over 3½ times.

Superpower was beginning to attract attention in 1920, and a transmission line to run from Boston to Washington, D. C., was proposed, into which all power sources would be connected. This line has not materialized, but it is now possible to tie together practically all the states east of the Mississippi River in a network of power lines. Boston, Mass., has been physically connected with Chicago, Ill., and Chicago with the power systems of the Southern States. To these might be added the power systems of Ontario and Quebec, Canada.

Double-Winding Generator

Large increases in system and generator capacity involve many problems of switching and control. One of these has been to provide sufficient switch capacity to handle the current of a single machine at generator voltage. For example, the current of the 160,000-kw. machine, previously mentioned, is 8,000 amperes. It is not possible to handle the current from such a generator with a single switch under abnormal conditions. To solve this problem the generator will have a double winding, making the machine the equivalent of two units in parallel. Each winding will be connected through its own oil switch to the busbars. In other cases the voltage of the machine has been increased above the 13,000 value, which was the maximum generator voltage uses until recently. The 100,000-kva. single-generator units installed by the Southern California Edison Company operate at 16,500 volts. In the State Line Generating Company's plant near Chicago, the 208,000-kva. triple unit will operate at 22,000 volts.

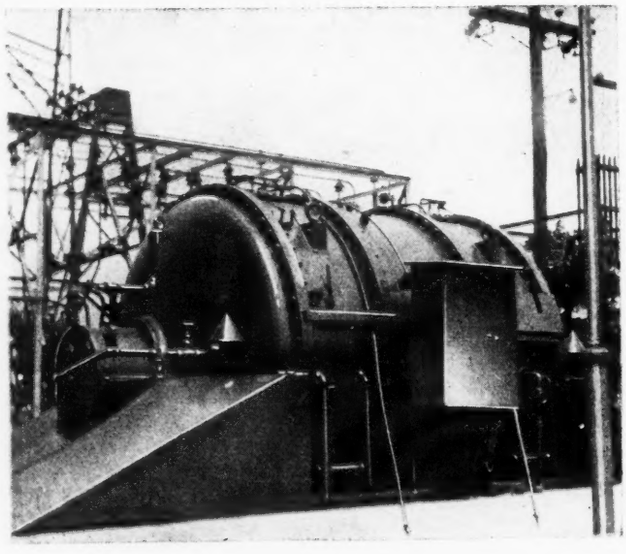
To improve system stability, quick response excitation has been applied to a number of waterwheel generators and synchronous condensers. On waterwheel generators the excitation is obtained from motor-driven exciters supplied with power from an auxiliary generator built into the main machine. Excitation systems for synchronous condensers have been designed for a maximum value of 1,000 volts, which can be applied at a rate of 6,000 to 7,000 volts per second.

The announcement made during last year, that two synchronous condensers cooled by hydrogen gas had gone into operation, marked the successful culmination of several years' experimental work with hydrogen gas as a cooling medium for electric machines. These machines, one rated at 12,500 kva., installed by the New England Power Company, and the other at 20,000 kva., installed by the Appalachian Power Company, are inclosed in a gastight explosion-proof cylinder. The heat absorbed by the hydrogen is removed by internal surface coolers, consisting of nests of tubes arranged concentrically inside the shell and close to each end of the casing. It is of interest that by the use of hydrogen cooling the capacities of the machines are from 25 to 50 per cent greater than with air cooling. These machines are installed out of doors.

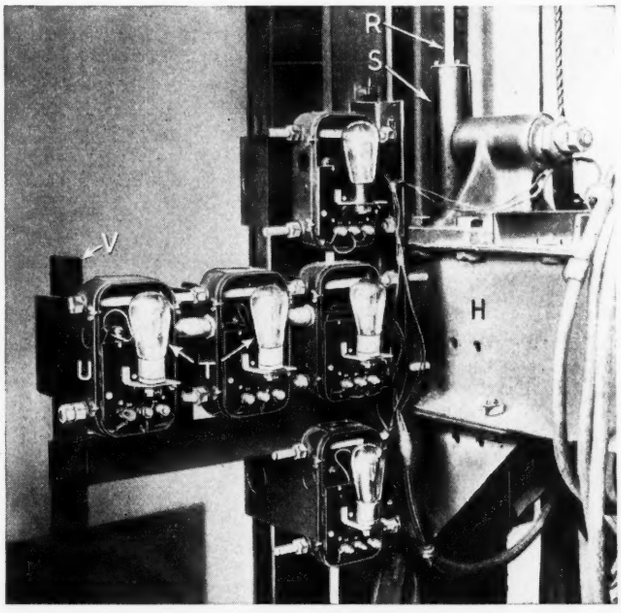
In the field of conversion equipment there has been an important advance in the development of variable-ratio frequency-changer sets. The advantages of these equipments are that it is possible to use sets of smaller capacity than of the synchronous-synchronous type and the amount of power and its direction can be controlled by relays. Two 25,000-kva. sets of this type have been installed by the Niagara, Lockport & Ontario Power Company. These machines are three times as large as any previous variable-ratio sets built in this country.

During recent years radical changes have taken place in the design of transformers. These changes have been so far reaching that present-day types of large power units bear little resemblance to their predecessors of five

Synchronous condenser, rated at 12,500 kva., cooled by hydrogen gas and operating out of doors



years ago. The use of tap-changing equipment for varying the voltage of transformers under load; voltage regulators used in combination with tap-changing equipment; devices for supplying an inert gas over the oil in the tanks; radiators for cooling the oil and systems for forced cooling of the radiators have changed the conventional type of transformer tank into a complicated-looking machine. Auxiliary cooling of the radiators is by two systems: One, by a unit blower supplying air blast to all the radiators, and the other using an individual blower on each radiator. Relays actuated by temperature con-



Pliotron tubes mounted on electric-elevator car crosshead to stop the car automatically level with the floors

H is the car's crosshead; *R*, guide rail; *S*, guide shoe; *T*, pliotron tubes; *U*, pliotron unit attached to the car's cross-head; *V*, pliotron operating vane clamped to guide rail.

ditions in the transformers start and stop the blower motors automatically.

Among the important transformer installations made during the year, attention is called to seven self-cooled units installed by the Philadelphia Electric Company. Each transformer is rated normally at 33,333-kva., but has its capacity increased to 43,333 kva. by the application of air blown against the radiators. For capacity in a single unit, the 83,333-kva. auto-transformer in the Charles R. Huntley station of the Buffalo General Electric Company is outstanding. This transformer steps the generator voltage from 12,000 up to 24,500.

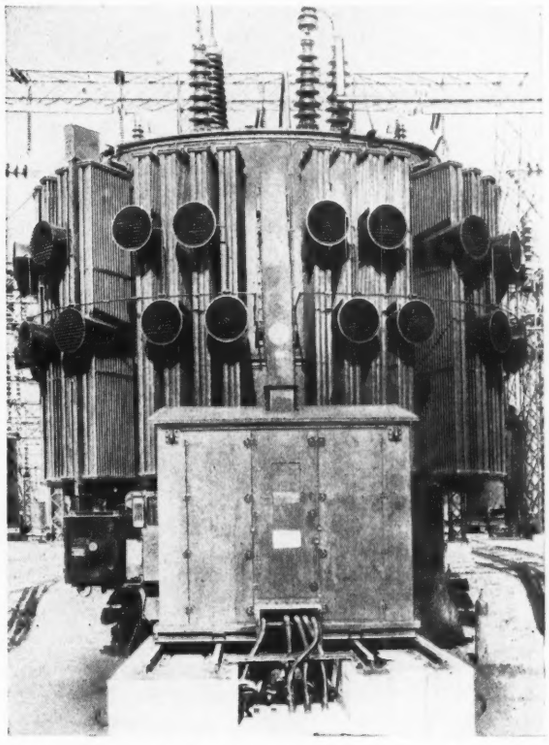
There has been an increasing tendency toward the use of high-speed motors for driving centrifugal pumps and air compressors. In this connection the 3,800-hp. 900-r.p.m. synchronous motors being installed in the Belmont pumping station of Philadelphia, may be cited.

There is also a decided tendency toward the use of line-start alternating-current motors. Most of the manufacturers supply squirrel-cage induction motors up to 30-hp. that are started by connecting them directly across the line. On certain applications induction motors of much larger capacity are started by connecting them directly to the line. It has become general practice to start slow-speed synchronous motors on full voltage. This practice has greatly simplified the starting equipment.

Synchronous motors continue to gain in favor and their field of application is expanding. A number of large motors of this type have been applied to steel-mill rolls, one of these rated at 9,000 hp. Some of the most difficult applications, such as hammer-mill drives in cement plants, are being successfully operated by synchronous motors. Such motors will develop 150 per cent full-load starting torque and 115 per cent pull-in torque. If the motors are loaded to where they pull out of step, they will operate as induction type and, when the load drops below 115 per cent full load, will resynchronize.

Mercury-arc power rectifiers are coming into quite extensive use. The first installation in this country was made in 1923. There are now about 60 of these installations in the United States and Canada.

Electric elevator development is tending toward making the control automatic. A development in this direction during the year was the use of pliotron tubes to stop automatically the car level with the floors. An oscillating circuit is created by the use of the tubes, coils and condensers. A relay coil is connected in parallel with a condenser in this circuit. When the current oscillations are high, only a small current flows through the relay coil. By damping out the oscillations, the current in the relay coil is increased to where it will actuate a relay to stop the car. The pliotron tubes are mounted on the car's



Self-cooled 43,333-kva. transformer with blower units on the radiator for cooling the oil

crosshead, and the oscillations are damped out by metal vanes located in the hoistway.

There are four manufacturers in this country who are building high-speed passenger elevator equipment that stops the car level with the floor. There are two classes of this equipment—one that stops the car level with the floor and maintains the level, and another that lands the car level with the floor, but does not adjust the level after the car stops. The former is known as automatic leveling and the latter as automatic landing, and both are coming into extensive use.

Oil Engine Production

Greater in 1928

WITH the year's total production in excess of 440,000 horsepower, 1928 cannot be said to have been a poor one for oil-engine builders in point of volume. As usual, Diesel installations have been divided among central stations, oil pipe lines, industrial plants and marine undertakings.

Among the central stations the largest unit installed was a 4,000-hp. Busch-Sulzer Bros. two-stroke-cycle Diesel at Tucson, Ariz., to supplement a similar engine installed in 1927. The total horsepower in this plant, 11,040, makes it one of the largest Diesel stations in the country. Another outstanding electric-service plant going into service was the Rockville Center, New York, municipal plant, containing three McIntosh & Seymour four-stroke-cycle units of 3,300 total horsepower.

In the Southwest the Texas-Louisiana Power Company installed several engines in various of its plants, notably in Texas City, where two 720-hp. Fairbanks-Morse two-stroke-cycle Diesels were placed in operation.

Diesels in capacities from 10 to 1,000 hp. have been installed in industries of widely varying character, including ice plants, silk mills, elevators and machine-tool plants.

The greatest sales activities have occurred in localities where the consensus of opinion has been that power could be purchased more cheaply than it could be generated in a factory plant. Among such plants are two in the Bronx, New York City. On Long Island, in close proximity to New York City, a number of Diesels have been purchased in spite of the high cost of fuel oil.

Who Uses Oil Engines

A number of ice plants have adopted Diesel drives. One holding company takes the position that unless electricity can be purchased for less than 1¼c. per kilowatt-hour any new plant will be equipped with oil engines.

The oil engine up to date has not been so universally adopted for contractor's shovel work as was anticipated. On the other hand, dragline excavators, logging machinery and dredges are being powered by Diesels to the almost total exclusion of steam engines.

While the automobile Diesel has received a tremendous amount of attention in technical and news publications, it has made no headway in this country, although a number of Diesel trucks are being built in Germany. This is due mainly to the cheapness of gasoline in America.

For small engines there has been considerable demand for tugs, ferryboats and work vessels. Most of these installations have been with direct drive, although a number of Diesel-electric units have been built. The outstanding installations are the 1,000-hp. McIntosh & Seymour engines, placed in sets of four on three reconditioned vessels, each equipped with one propeller motor. With the exception of the Shipping Board purchases of 3,000- and 4,000-hp. Diesels, there has been little interest shown in motorships in this country. This is in direct contradiction to the activity in European shipping, where most of the new vessels are being Dieselized. To make the picture more gloomy, the Shipping Board has announced that no more of its ships will be reconditioned. Probably cheapness of coal is one factor that makes the steamer attractive to the ship operator, for even if a ship burns bunker oil the price is set to meet the price of coal.

Manufacturers must construct their engines to burn the cheap boiler oil, or when such oil can be used in present designs the builders must recommend the low-grade oil. The formation of a joint committee representing the builders, the users and the marketers, under the auspices of the Gas and Oil Power Division of the American Society of Mechanical Engineers, to set up oil standards, should do much to clarify the situation.

The electrification of certain oil fields and pipe lines has had a detrimental influence on the oil engine. However, purchased current has not met with complete satisfaction, and at present the trend is back toward the oil engine. Two large orders for pipe-line Diesels were placed during the year.

Rapidity of design change seldom occurs in any power equipment, and this is especially true of oil engines. Experiments are carried on for several years before an engine is a commerical possibility. During this time the several phases of development are more or less broadcast. Consequently, it is impossible to credit any specific year with outstanding progress.

A New Design

Of the new engines announced during the year, the double-acting two-stroke-cycle unit of the Sun Shipbuilding Corporation, Chester, Pa., is the outstanding one. This engine has but a single set of scavenging and a single set of exhaust ports. This reduces the engine height an appreciable amount. It is a standardized design, the plan being to construct engines of from one to eight cylinders with identical parts.

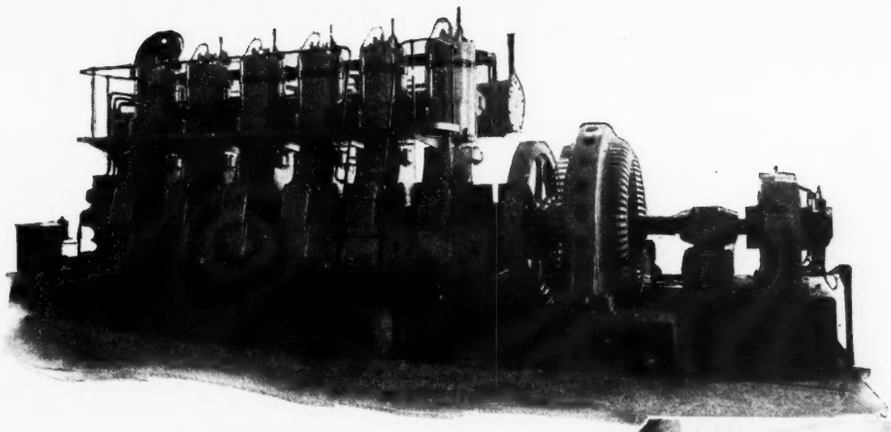
Although European engineers have embodied mechanical fuel injection in designs of engines up to 10,000 hp., the American builders have approached the problem with more conservatism. There is, nevertheless, a distinct trend toward the elimination of the injection-air compressor. One builder offers engines of this design up to 800 hp., while the De La Vergne Machine Company, the pioneer in solid-injection development, has built a 1,600-hp. unit. This is the largest compressorless engine so far constructed in this country.

For engines under 500 hp. the pump-injection engine almost monopolizes the field.

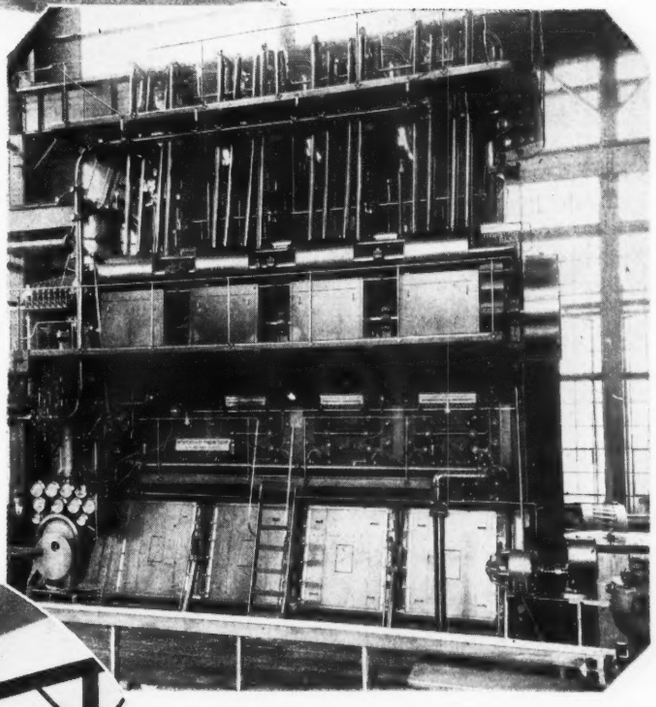
A number of builders have speeded up their units and large engines of 400 r.p.m. are procurable.

In the low-power engines, ranging from 25 to 300 hp., no notable improvements have been made, but a number of designs of light-weight high-speed Diesels have been made available, notably the Atlas-Imperial truck engine.

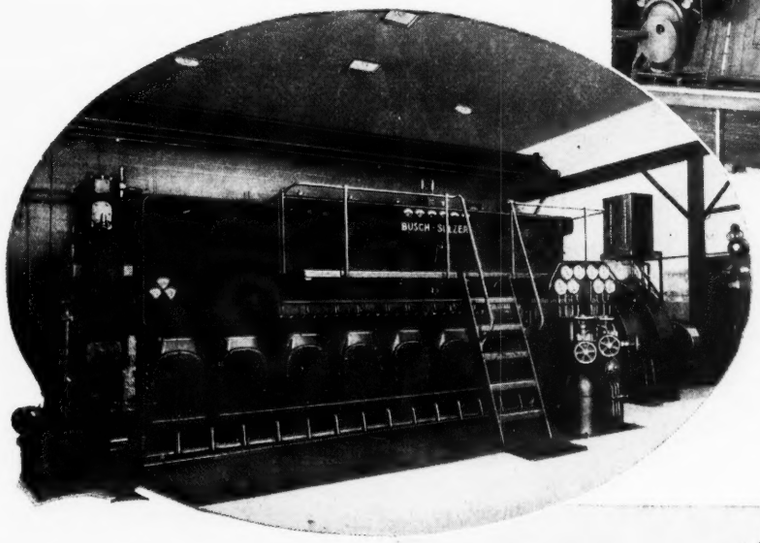
The Packard Motor Company has built a high-speed airplane engine. This has attracted much favorable comment, but its serviceability remains to be proved.



Above — A 360-hp. Diesel for stand-by service in a Maine cement mill where the load is usually carried by water power

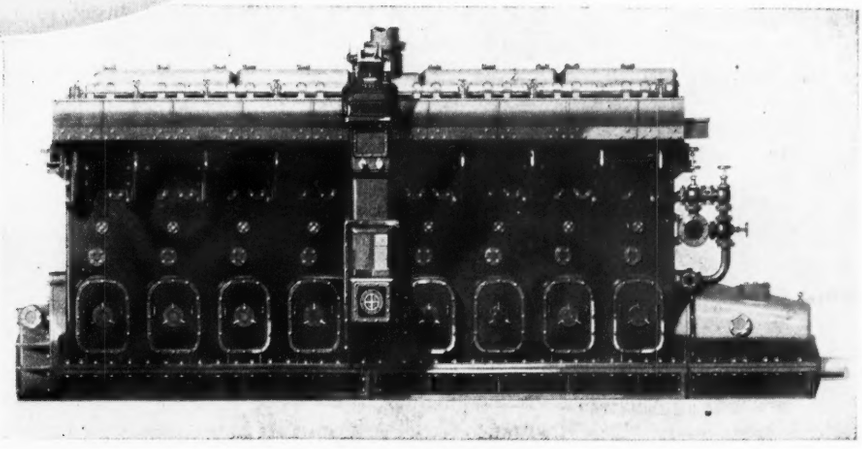


Below—An 800-hp. high-speed engine insures continuity of service on a Nevada hydro-electric system when the water flow drops



Above — A 3,000-hp. double-acting engine for the Shipping Board

Below — A high-speed 1,500-hp. yacht Diesel installed during 1928



New Refrigeration Systems

MAKE THEIR APPEARANCE

APPARENTLY, refrigerating engineers have decided that the household refrigerating machine is a commercial actuality, for during the last year more attention was given to the application of refrigeration to industries than to ice making.

There was not that activity in the consolidation of ice-plant properties that existed in 1927. Some of the holding companies found that the excessive prices paid for run-down plants prevented the realization of the expected operating profits. Without the usual demand for ice-plant equipment, machine builders and designers gave attention to the industrial requirements for refrigeration.

Activity was marked in the field of air conditioning for theaters, hotels and like public buildings. This has entailed refrigerating machines of both centrifugal and reciprocating types.

Other industrial applications include slate shingle quarries, candy factories, rayon mills and dairies.

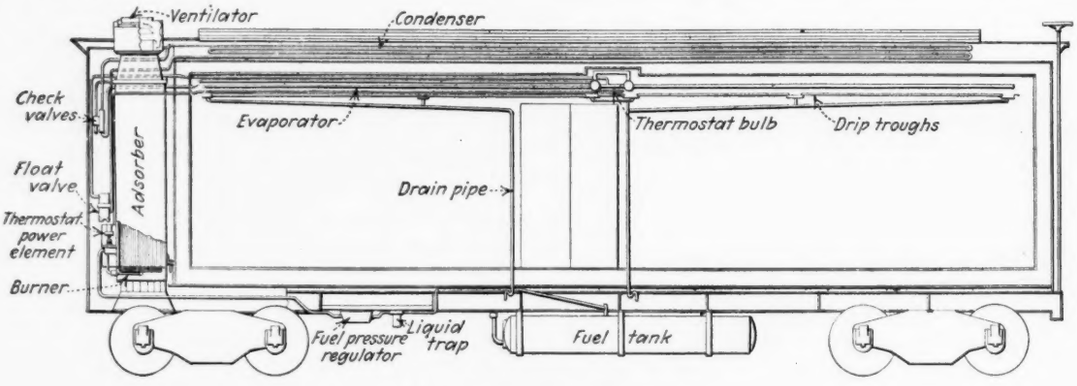
In addition almost all of the firms building refrigerating equipment have brought out small units to meet the demand of apartment houses, office buildings and ice-cream distributors. Such machines are a compromise between the miniature household machine and the larger commercial plant.

The more extensive use of carbon dioxide, or "dry ice," as it is often called, has been marked. Shipments of fish and fresh fruit have been made with the CO_2 as the refrigerant. With the placing of a CO_2 extraction plant in commercial operation, it has been possible to obtain supplies at a price justifying the use of dry ice for ice-cream wagons and retail containers, as well as in fish shipping packages.

A second advance of considerable moment was the successful application of silica gel refrigeration to railroad refrigerating cars. This system, to be described in a later issue of *Power*, eliminates the bunkers of such cars and substitutes a sulphur-dioxide refrigerating system in which the compressor is replaced by silica gel. Fish cars with this system have made journeys of 2,000 miles with entire success. Since railroad-car icing plants total many thousands of tons capacity and have been a good market for equipment. The advent of the silica gel system, many feel, portends a still further decrease in the installation of purely ice-making equipment.

A third development of the year was the "cracked-ice" machine. Years ago a machine was built in which a large cylinder containing a refrigerant was partly submerged in a water tank. A thin coat of ice or frost deposited on the cylinder, and this was shaved off as the cylinder rotated. The frost was then compressed into cakes.

Recently, the same basic idea has been elaborated upon by making the cylinder semi-flexible so that the ice deposited on the cylinder is cracked off in flakes. These flakes are used in place of cracked ice in covering vegetables in transit. The freezing time is much less than with ice cans, and the floor space is decidedly reduced. The ice so manufactured cannot be compressed into cakes of a quality approaching the commercial article, consequently the greatest use will be for top icing of vegetables in transit and for fish and ice-cream packing.



The silica gel refrigerator car

In the household machine field no new designs have been introduced during the year. However, the sales have increased to a marked extent, although the sales cost has been so high as to prevent a number of manufacturers making a fair profit; some, indeed, have suffered heavy losses. Apparently, the mechanical end of the industry has become stable and satisfactory, but much remains to be done in the marketing of the product on a profitable basis.

The development of the household gas-fired absorption system has turned engineers' attention again to that neglected cycle. A number of large commercial absorption plants have been installed, and there is every reason to believe that for industrial applications where large amounts of low-pressure steam are available, the absorption system will once more gain popularity. Its decline in the past has been due to the failure of the operator to understand the principles of operation.

POWER EQUIPMENT

Shares in National Prosperity

By A. D. Blake
Associate Editor, Power

Reports from a number of representative manufacturers of power equipment show average sales for 1928 substantially above those of 1927, indicating that the field has been in line with general business trends during the year. Figures are quoted for several major groups of power equipment.

THE momentum attained by business throughout the year, culminating during the last few months of 1928 in a new high mark, should at least augur a good start for 1929. Construction in 1928 exceeded that of 1927 by over 16 per cent. Conditions in the automobile, iron and steel, chemical, rayon, electrical and machinery fields are especially active; the sugar, leather, packing and rubber industries are good; and material improvement is reported in several lines that were operating on a low scale during the first half of 1928. This applies especially to certain industries in New England, such as textiles and mechanical equipment.

That this general situation is reflected in the power-plant field is borne out by reports from a considerable number of equipment manufacturers, over two-thirds of whom show increased business over 1927, ranging from 10 to 50 per cent. Of the remainder a few report sales about the same and a few a slight decrease in sales. The latter are mostly in lines affected by changing practices in the field or where competition is particularly keen.

While margins of profit have been smaller, due to a prevailing buyers' market attended by price cutting, increased competition and incessant demands for special designs necessitating costly development work, the volume of business has been such as to insure increased earnings in most cases.

In line with present trends the field has witnessed a number of consolidations during the year aimed at eliminating duplication of effort and the rendering of better and more complete service. This was especially notable in the boiler industry, which has been laboring under too much productive capacity.

More electricity was produced by central stations in the month of October than ever before in any one month. Figures compiled by the United States Geological Survey give a total of over 7,900,000,000 kw.-hr., which is 14 per cent above those for October, 1927. While authentic reports for November and December are not yet available, indications are that they will at least measure up to October. Although the increase in output is higher than the increase in installed capacity, which was about 10 per cent, extensive interconnection of plants and systems during the year has made possible this greater output. The total central-station production for 1928 is estimated at 88 billion kilowatt-hours, showing that the output has more than doubled in the last seven years.

Reports from the Department of Commerce for the first ten months of 1928 show a slight increase in both the number of boilers and the square feet of heating surface sold. While the gain is not commensurate with the increase in steam power, it must be remembered that boilers are now being driven regularly at higher rates, better average efficiencies are maintained, and there has been in many cases a redistribution of heating surface with the use of water-walls, air preheaters and economizers, all of which factors tend to hold down the volume of sales. Moreover, the trend toward large boilers reacts in favor of those firms able to build such units.

In the aggregate, manufacturers of air preheaters, economizers, and draft equipment show a greater volume of business in 1928 than in 1927. The fact that there are a few more firms in the preheater line has increased competition and adversely affected some individual manufacturers.

Several makers of boiler fittings and boiler-room accessories report a record year, and the average is well above last year. With some there was a peak during the last quarter. One firm shows a steady increase, with only month behind that of 1927 and a sprint of orders during the last quarter. Another reports an average increase of 8½ per cent, with a jump in September; while a third claims a 25 per cent increase.

With fuel-burning equipment, as in the case of boilers, the trend toward higher sustained outputs precludes in-

creased power production being reflected directly in the amount of equipment sold.

Reports from several makers of pulverized-coal equipment indicate, on the average, a volume of sales about the same as last year, although one well-established firm shows an increase of 50 per cent with present bookings well above any period of the year. Two more firms show a slight shifting in favor of stoker sales as compared with the situation of a year ago. It is apparent that improvements in stoker design, enabling them to meet new conditions, and a realization on the part of buyers that pulverized coal and stokers each have their place, are working toward a more satisfactory division of the business.

Stoker Sales Show Some Gain

In spite of a slacking up in stoker sales during the early fall, the number sold during 1928 will exceed those sold in 1927 and the total capacity will be greater, according to figures compiled by the Department of Commerce from manufacturers' reports up to December first. There was a noticeable increase in the stokers sold for use with fire-tube boilers, a fact that may be traceable to renewed activity on the part of smoke inspection departments of several cities in enforcing ordinances among the smaller plants.

The tendency to employ furnaces either totally or partly surrounded with water walls in connection with large boilers, for both stokers and powdered coal, has meant greatly increased business for the water-wall manufacturer. This ranges from a small increase to as high as 50 per cent. The fact that several additional firms have lately entered this line may change the picture somewhat during the coming year so far as the individual manufacturer is concerned, although the total volume is sure to increase.

While this trend has adversely affected a few manufacturers of refractories, it applies more particularly to the large boilers driven at high combustion rates. Moreover, refractories are being used extensively in connection with water walls, and there will always be a demand for the better grades of refractories. Two companies report an increase in sales of approximately 25 per cent, spread well over the year with the exception of the first three months; while a third shows a decrease of 10 per cent.

Industrial Plant Business Contributes Increased Turbine Sales

Turbine sales during the year appear to have been well above the average. This applies to small as well as large machines. A number of unusually large turbines were installed in central stations, and rehabilitation of industrial plants has resulted in many high-pressure and bleeder turbines being employed in connection with steam supply to process. Of six firms reporting, the figures, with one exception, show gains from 5 to 50 per cent, with an average of 20 per cent. In the one exception noted the sales were approximately the same as last year.

Among condenser builders there has been some shifting of business, but the total volume remains about the same. Where large units are concerned, the shifting of only a few orders will mean a good or bad year for the individual manufacturer.

The demand for pumps appears to have been somewhat above the average, especially during the second half of the year. While several firms report the volume of sales about the same, others show gains ranging from 8 to 20 per cent. A considerable number of pumps were exported last year.

Although 1928 showed an encouraging gain in the number of oil engines built, unfortunately much of this business was taken at low prices, especially large units. Satisfactory prices have been obtained in the main only where the equipment has been sold on a long-term financing plan. The underlying reason for the existence of low prices has been the same as that existing in some other lines, namely, excess manufacturing facilities. But the oil-engine builder has the advantage in that he has an opportunity to enlarge his market by a more comprehensive sales campaign. One or two firms have already taken the lead in this respect.

Seasonal business, such as ice plants, cotton gins, irrigation and plant additions, showed some improvement compared with last year. In the marine field greater tonnage of Diesel ships than of steam ships was turned out by the shipyards of the world. The ability of foreign Diesel builders to undersell American firms threw most of this business abroad, particularly in the case of a number of American owned vessels. In spite of this handicap several large vessels were re-engined during the year with American-built Diesels. Finally, the recent reduction in the price of boiler oil lessens the advantage of the Diesel over steam from the fuel economy point of view. This latter condition may, of course, be regarded as more or less temporary in view of the present situation in the oil industry.

Pipe Line Extensions Stimulate Gas Engine Building

During the year construction was started on a number of gas pipe lines from the Texas and Oklahoma fields to Denver, Kansas City and St. Louis. This has stimulated activity in the gas-engine field.

The situation with steam engines remains little changed from that of last year. Increased orders during the last quarter of 1928 are indicative of 1929 being up to the last two years. The steam engine is still very much in the running and there are indications that the adoption of very high pressures for industrial plant service may open up new opportunities for this type of prime mover.

The foregoing is a general picture of conditions in the field as they affected a number of representative manufacturers. Obviously, it will not apply to all firms making power equipment. Sales policies, acceptance of the product itself, ever-changing power practice and competition may place individual firms well above or below the average. The figures do show, however, that the field has been in line with general business trends for the year and especially the last quarter, which on the average is far ahead of the last three months of 1927, during which, it will be recalled, things slowed up in many lines.

Throughout the country optimism and confidence prevail, strengthened, perhaps, by the election of Mr. Hoover. In view of this 1929 is off to a good start that presages business activity of healthy proportions during the first quarter. Beyond this, prediction would not be well founded. Should certain unfavorable economic factors work toward a readjustment and slowing down during the year, it is reassuring to know that conditions over the country are basicly sound. Moreover, the diversity in power utilization is very large, which causes it to be little affected by the fortunes of any particular industry.

American Industry 74.4 Per Cent Electrified

By Robert M. Davis
Statistical Editor
McGraw-Hill Publishing Company

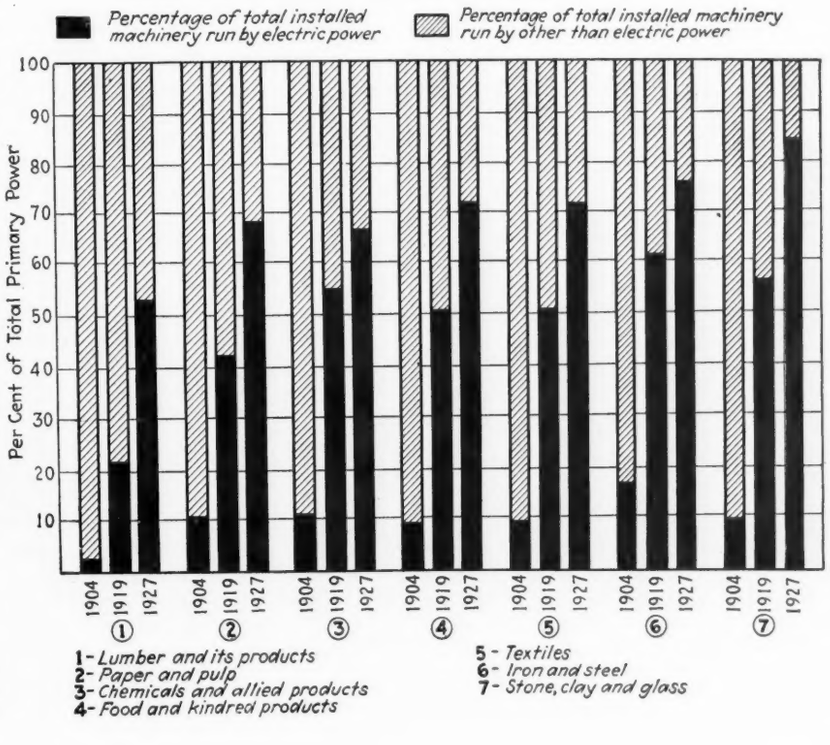
Electrification Includes Motors Run by Both Purchased and Privately Generated Power—Power per Wage Earner Now 4.7 Hp.

FEW realize the great strides that have been made during the last few years in the electrification of American industry. Even those close students of power developments and trends are astonished at the figures on electrification which are now being issued by the United States Census Bureau as a part of the 1927 Census of Manufactures. Not all these 1927 data are available as yet, but the industries for which data are available indicate a radical substitution of electrical energy for steam power and other power.

Foreign nations wonder at the great prosperity of the American people during the last few years. Many theories are advanced for the fact that today, according to the National Industrial Conference Board, the purchasing power of the nation as a whole in deflated dollars or real purchasing power is 55 per cent over that of 1909, and in current dollars is 173 per cent over 1909; also that the increase in real purchasing power per capita is 20 per cent over 1909, and that of the gainfully employed is 35 per cent over 1909. While European nations continually contend with unemployment, high prices and low wages, the American wage earner finds plenty of work for his hands to do, and receives therefor a wage that allows him to enjoy material pleasures and to purchase commodities that are restricted to the wealthier classes in foreign countries. While other nations measure their economic gains almost by the aid of a micrometer, the United States completes a year of record operations in general industry, with earnings of corporations beyond any previous figure. While foreign nations enter the new year with dread of what it may contain for them, the American business man faces the future with optimism and confidence in the fact that under the leadership of an economist and engineer the prevailing prosperity will continue to a greater or less degree, not over one year but over an entire four-year period.

Our foreign brethren will find the answer to this favorable situation to be the resultant of a number of economic forces that have been intensely at work in this nation during the last ten years. Increased juvenile and adult education, a sound financial structure, scientific business and industrial management, the encouragement of private initiative in business with a minimum of governmental control, quick and cheap transportation, pure and applied research, and, last but not least, the elimination of slow and costly production methods in favor of mass production and more efficient machinery. In fact, without the present-day mechanical equipment and power available the high degree of American productive operations, high wages and low cost of commodities would be an

Fig. 1—The stone, clay and glass industrial group is the most highly electrified at present



impossibility. Few factors have exerted a greater influence upon the development of the American wage earner than the gradual increase in the use of machinery. During the last 60 years a very significant change has taken place in the economics of American production. We have transferred the work of industry from the backs of men to the inanimate forces of steam and electricity. In 1869 only 1.14 hp. was installed in American factories per wage earner. This installation increased very slowly during the next 20 years, until in 1889 only 1.4 hp. was installed per wage earner. Then opened a period of more rapid development, reaching its peak at the close of the World War, when the mechanical power installed per wage earner had reached the total of 3.24 hp. With the present decade came an abrupt upward swing of new power installation which has resulted in more installed power being added per wage earner from 1920 to 1928

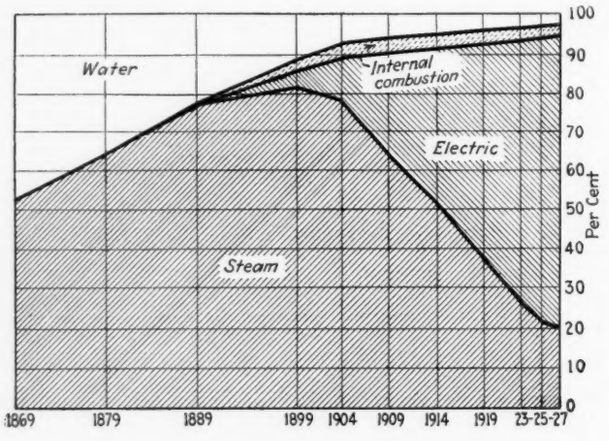


Fig. 2—Electrically driven machinery now holds first place in American manufacturing plants

than was added during the 25 years previous. Today the power per worker in our mills and factories totals 4.7 hp., an increase of 45 per cent since the World War and over twice the power installed per wage earner at the opening of the decade.

The last 24 years, however, has witnessed a material change in the type of power that has been placed at the service of American labor. Prior to 1889 practically all the machinery was driven mechanically by steam and water. Endless shafts and belts clogged the mills and factories of the nation, and efficient and rapid operation of machinery was next to impossible. But with the advent of the electric motor American industry entered a new era. Its adoption was rapid. From 1904 to 1919 the installed electrical horsepower per worker increased from 0.3 to 1.8, an increase of 500 per cent in the fifteen-year period. But since the war this installation has increased to 3.5 hp. per worker, leaving less than 1.2 hp. of other drive installed per worker.

Water power has gradually been eliminated as a direct

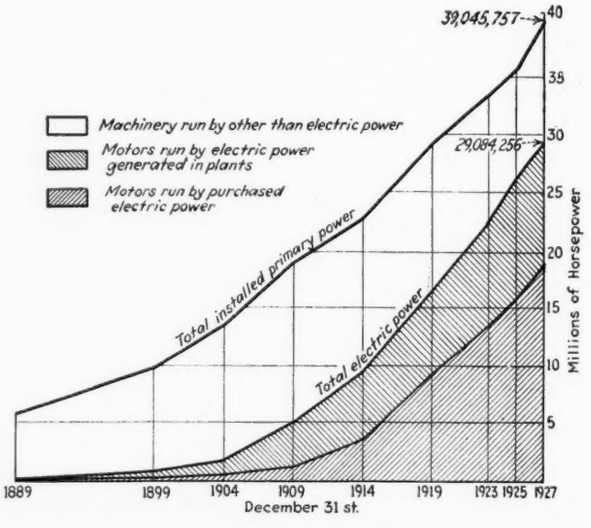


Fig. 3—Central station energy now supplies almost two thirds of the electric motors and half the power in manufacturing plants

source of motive power for American industry. In 1869 almost 50 per cent of the installed machinery in the nation's manufacturing plants was run by shafts leading from waterwheels. Steam power gradually cut this down until, by 1889, only slightly more than 20 per cent of the production machinery was connected to waterwheels. Then came the new power giant electricity and the small brother the internal-combustion engine. Starting slowly, the electric motor gradually gained momentum, displacing direct steam-driven machinery until by the close of 1927 the line-up of power-driven machinery in American mills and factories showed 74.4 per cent motor driven, 20.6 per cent steam driven, 3 per cent driven from internal-combustion engines, and only 2.0 per cent driven directly from waterwheels and turbines. Electrical energy, privately generated and purchased, then, today is the power running practically three-quarters of the nation's installed machinery. The trend is still distinctly toward a further proportionate increase in the amount of elec-

TOTAL INSTALLED PRIMARY HORSEPOWER AT THE CLOSE OF 1925 AND 1927

(1927 Estimated on Latest Date Available)

Group	Aggregate Horsepower		Owned								Purchased Power	
			Steam Engines, Hp.		Steam Turbines, Hp.		Internal-Combustion Engines, Hp.		Waterwheels and Water Turbines, Hp.		Electric Motors, Hp.	
	1925	1927	1925	1927	1925	1927	1925	1927	1925	1927	1925	1927
Food and kindred products	3,881,952	4,248,211	1,417,989	1,322,185	242,342	261,642	177,417	196,972	109,392	118,765	1,934,812	2,348,647
Textiles and their products	3,986,136	4,349,941	1,101,373	1,179,683	755,822	821,010	19,068	20,279	460,951	507,074	1,648,922	1,821,895
Iron and steel	7,518,990	8,299,571	3,035,612	2,355,318	1,428,871	1,796,969	599,456	538,934	19,050	17,826	2,436,010	3,090,524
Lumber and its products	3,472,770	3,164,285	2,088,709	2,009,065	404,891	427,970	57,959	55,503	48,448	49,907	872,763	621,840
Leather and its products	413,759	454,324	158,004	172,903	54,099	59,485	4,434	4,784	4,955	5,223	192,267	211,929
Rubber products	656,857	1,011,992	82,487	105,971	145,617	204,093	294	1,325	3,241	3,654	425,218	696,949
Paper, printing & related industries	3,060,794	3,186,044	672,942	614,269	422,689	526,791	12,020	13,069	934,372	774,048	1,018,771	1,257,867
Chemical and allied products	2,984,913	3,229,224	448,151	1,003,644	681,773	791,011	79,468	90,194	154,596	169,684	1,120,925	1,174,691
Stone, clay and glass	2,348,157	2,585,022	571,508	558,096	366,406	448,255	111,836	119,491	29,096	30,922	1,269,311	1,428,258
Metals and metal products	1,158,486	1,694,288	236,573	245,446	194,627	279,826	20,947	21,312	7,299	9,077	699,040	1,138,627
Machinery, not including transportation equipment	2,714,377	2,977,951	377,454	338,231	355,738	406,116	63,762	59,255	22,166	20,356	1,895,257	2,153,993
Musical instruments and phonographs	97,318	101,955	34,434	32,079	23,255	29,801	748	728	220	383	38,661	38,964
Transportation equipment	1,888,961	1,920,108	271,920	230,907	308,773	222,436	16,766	16,703	1,487	9,067	1,290,015	1,440,995
Railroad repair shops	942,248	1,108,641	286,340	281,252	66,264	146,839	4,823	6,525	32	482	584,789	673,543
Miscellaneous industries	646,901	714,200	150,892	169,797	31,301	35,093	17,068	19,254	5,523	4,522	442,067	485,534
Totals	35,772,628	39,045,756	11,434,388	11,118,846	5,482,468	6,457,327	1,186,116	1,164,327	1,800,828	1,720,990	15,868,828	18,584,256

trically driven machinery as against all other types of power, and it seems probable that by the opening of the next decade 77 per cent of the primary power installed in American mills and factories will be electrical.

There are nine states in the Union in which over 80 per cent of the primary power installed in mills and factories is electrical. Maryland leads with a 92 per cent electrification, followed by Illinois with a 90 per cent electrification. The lowest degree of electrification of factory equipment is to be found in Mississippi, where only 25 per cent of the machinery is electrically driven.

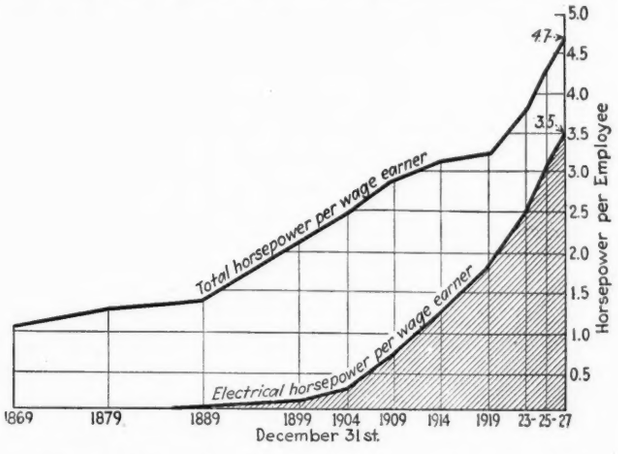


Fig. 4—Installed electric horsepower per worker has been increased by 95 per cent since the war

Turning to the various industrial groups, it is found that the stone, clay and glass group is the highest electrified at the present time, the present degree of electrification being 83 per cent. During the last ten years this group has shown the greatest percentage increase in electrification of any industrial group with the exception of the lumber industry. The iron and steel industry has also adopted the electric motor to a large extent and stands second, with an electrification of 75 per cent. Other industries follow with the textiles reporting a 71 per cent electrification, food and kindred products 71 per cent, chemicals and allied products 67 per cent, paper and pulp 68 per cent, and the lumber and its products group with a 52 per cent electrification. At the close of the war the iron and steel industry led in the degree of electrification followed in order of electrification by the stone, clay and glass group, chemicals and allied products, textiles, food products, paper and pulp, and the lumber and its products industry. At the opening of the century the iron and steel industry led all industries, but with an electrification of only about 17 per cent against 75 per cent in 1927.

Electrification of American manufacturing plants started with the opening of the first central station in 1882, but for the first 25 years the private electrical generating plants carried a major portion of the nation's industrial electrified load. Since 1914, however, the connected load of the private generating plants has developed slowly, increasing by only 112 per cent during the last thirteen years, while the industrial connected load of the central electrical stations of the nation has increased from 3,897,248 hp. to 18,584,256 hp., at the end of 1927, or an increase of 378 per cent during the same period. There is a destined place for the private plant, but its expansion is limited to the larger mills and factories.

New Index of Industrial Operations

The high degree of electrification of American mills and factories has made possible an entirely new measure of manufacturing operations. During the last five years a barometer of manufacturing operations has been evolved based upon the monthly consumption of electrical energy by over 3,600 manufacturing plants in various industries and scattered throughout the nation. Today this electrical indicator is accepted by practically all economists and students of industry as the timeliest and one of the most accurate indexes of general manufacturing operations available. Not only is it possible to present indexes for each industrial group as well as for industry in the composite, but it is possible to present these indexes for each section of the nation, and even to evolve indicators for each city or state. Such indicators are now available within ten days after the close of the month. This electrical barometer of American manufacturing operations has been especially conspicuous during the last year in pointing out the record operations of industry weeks before the old indexes were available to the public.

The American power industry faces the coming year with every confidence of a high degree of industrial operations. It is practically certain that the first quarter of the year will record rates of industrial activity above those during the same period last year, and the present economic strength of the nation under the direction of Mr. Hoover would seem to warrant the assumption that the year 1929 as a whole, will witness an average degree of industrial operations which will at the least compare favorably with the so-called "good years." There is nothing on the horizon as the year opens of sufficient importance to warrant other than an optimistic outlook.

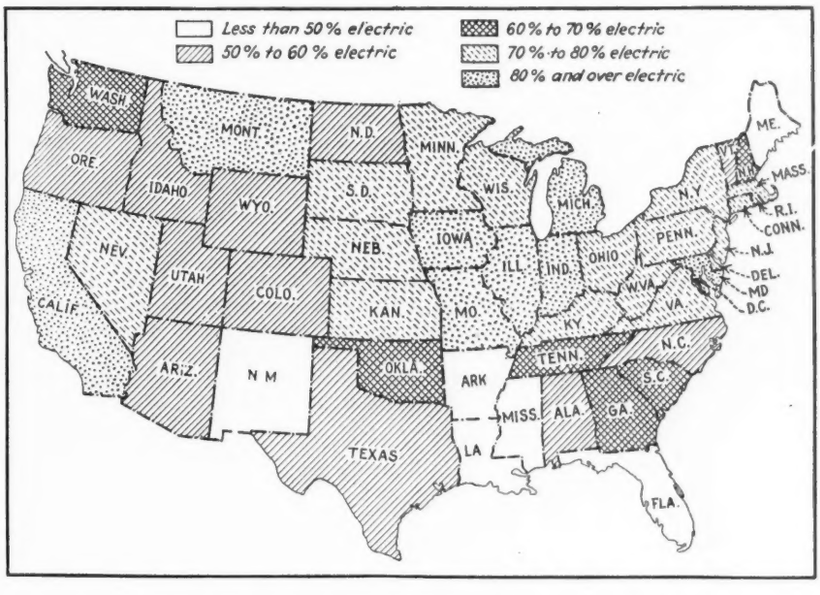


Fig. 5—Degree to which industries of the states depend upon electricity

Economic Factors Dominate

Power Situation in Europe

By George A. Orrok
Consulting Engineer, New York

There is a growing conviction abroad that more power in industry is the key to prosperity and better labor conditions. Technical developments that form a part of the picture through better utilization of fuels, higher efficiencies and adequate power supply for important districts, are reviewed.

THE last year has not been outstanding as to new or startling developments in the power field. The countries of Europe have been consolidating their financial positions, stabilizing their currency and exchange, readjusting their many channels of trade and commerce and planning for further expansion of trade and manufacture. Tariffs and cartels, employment problems, the "full dinner pail" and other industrial and economic problems have fully occupied the minds of the leaders of industry, and engineering and trade congresses have taken the economic viewpoint rather than the scientific.

That there has been a much closer scrutiny of the economic side of the power industry is well shown by the papers and discussions at the Fuels Section of the World Power Conference which took place in London, Sept. 24 to Oct. 6. This meeting followed almost immediately the publication of the report of the National Fuel and Power Committee which had been appointed by Sir Philip Cunliffe Lister, the president of the Board of Trade, in August, 1926, with Sir Alfred Mond, now Lord Melchett, as chairman, "to consider and advise upon questions connected with the economic use of fuels and their conversion into various forms of energy, having regard to national and industrial requirements and in the light of technical developments." This report, a 37-page pamphlet, presents an interesting picture of the fuel and power situation in England, and its recommendations include, as a parliamentary report should, many clauses having a commercial and economic bearing, but most interesting and valuable to the producer and user of power.

Similar reports of commercial and governmental agencies have been made public in other European countries, and even the meetings of the engineering societies have shown less of the scientific and more of economic leanings. The list of subjects for discussion at the proposed Berlin Meeting of the World Power Conference in 1930 shows that it will be frankly an economic conference rather than one of scientific trend toward engineering, as were the earlier meetings.

It would be too much to say that the leaders in European industry have been converted by the gospel of Foster and Catchings in "Profits" and "Business Without a Buyer," but it would appear that they have sensed the idea that the more power is used in industry, the more horsepower provided for the individual workman, the larger the production and the greater the returns of labor. England, France and Germany are planning to double their electrical power output at the earliest possible moment. Most of the other European states have plans of a similar nature in various stages of construction, while the distribution of gas over large areas is well under way. Quantity production, the saving of waste, collective buying and selling, overrunning even tariff walls, are all signs of a newer sort of economic thinking which became more evident in 1928. Even organized labor is beginning to see that "ca'canny" and restriction of output mean higher costs and less returns, and the industrial situation has been distinctly better than in 1927.

Future Power Supply of Berlin Being Studied

In the power field some of the larger aggregations have been studying the future carefully, and the appearance early in the year of "Zur Zukunft der Berliner Elektrizitäts Versorgung" (The Future of the Berlin Electric Power Supply), by Director Rehmer and his assistants, is most interesting. This pamphlet is in three parts of about 30 pages and contains the curves of growth, estimates of costs of extensions and a general discussion of the many problems Berlin will have to face in the next ten years. The discussion is all the more valuable since Berlin resembles American cities perhaps more nearly than other European cities. It is also interesting that the new Northwest (Spandau) Station, which will contain six 35,000 A.E.G. turbines served by 12 Borsig-B. & W. boilers with Taylor stokers, will work at 350 lb. per sq.in. and is estimated to cost about $60 per kw. The station coal rate will not be much different from the 525-lb. Klingenburg station now in service as a base-load station with powdered-coal firing. These studies included purchase, base and peak power from Golpa (Zchornewitz), a brown-coal station 70 miles away, a Ruths accumulator installation at Charlottenburg (a combination heating and power plant with 200- and 400-lb. boilers), and a 240,000-kw. water storage battery plant at Havel working under about 240 ft. head. The report is carefully written and will repay much study.

The Böhlen station below Dresden has been put into service. This plant is owned by the State of Saxony and is tied in with the Golpa, Hirshfeld and Trattendorf brown-coal plants. This station was described by Doctor

Rosin in his excellent paper at the Fuel Section of the World Power Conference at London in October. This plant is a combination briquetting plant and power supply station. The briquetting plant handles about 10,000 tons of raw brown coal per day and produces 2,000 tons of briquets for railroad and household consumption. The dry dust from the briquetting and drying process is fired in powdered form under modern boilers, while such additional steam as may be required is generated by firing raw brown coal on the customary stepped grates. The turbine room has nine units—three small high-pressure units, aggregating 32,000 kw., furnishing the exhaust steam for drying the brown coal, and six condensing units aggregating 165,000 kw. As is usual in the brown-coal regions, little water is available for condensing purposes and six large cooling towers are provided. Reports indicate that the dual operation is successful and commercial, but figures are not yet available as to the cost of power. Other brown-coal plants are extending their capacity, Golpa, in particular, where 175,000 kw. in two new machines will soon be in operation. This type of plant has many attractive features, and at least three other plants are in contemplation.

Combination Low-Temperature Carbonization and Electric Plant

Among the experimental plants of the combination type the Dunstan plant of the Newcastle-on-Tyne Electric Supply Company has attracted much attention. This combination of a low-temperature carbonization plant with the production of electricity was described for the first time by R. P. Sloan, of the Newcastle company, in one of the World Power Conference papers. This plant consists of two 18,000-lb. capacity B. & W. boilers set in battery, each with one retort, and one 36,000-lb. capacity boiler with two retorts, while one 36,000-lb. capacity boiler without a retort and fired with powdered coal serves as a reserve and peak unit to carry the fluctuating loads when required.

The coal is screened on arrival at the plant, all the fines going to the mills for firing under the powdered-coal boiler. The lump coal is fed into the preheaters and then into the retorts for carbonization. The retorts are fired with producer gas or with coke-oven gas, which is sometimes available. The gas and tar are exhausted to the byproduct plant and the non-liquefiable products burned at the rear of the boilers. The coke is charged hot onto chain-grate stokers and is the main source of heat in the four retort boilers. Mr. Sloan gives figures showing that from one ton of coal costing 12 shillings, he gets coke and gas fuel valued at 9.12 shillings and byproducts selling for 10.5 shillings, an increase in value of over 63 per cent. This 7.62 shillings must pay fixed charges, labor and profit. Meanwhile the subject of combination plants is arousing interest and without doubt other experiments of this character will be given a tryout in the near future.

The interest in low-temperature carbonization and its allied aspects, complete gasification and hydrogenation, continues to increase because of the varied conditions under which the processes may be used. Sir Arthur Duckham has built, in connection with the Fuel Research Board at Kingston-on-Thames, a bank of 40 retorts with a carbonizing capacity of about 200 tons of coal per day. George Helps at Nuneaton claims excellent results from Maclaurin retorts and claims the gas problem is solved with his 200 B.t.u. gas. In Germany it is expected that the supply of lignitic semi-coke will be found to exceed the demand by 200,000 tons for the year, but several more plants are projected; meanwhile attention is turned to the burning of this semi-coke in powdered form. In France the experiments are still on a small scale. In fact, France is much more concerned with the development of her water powers in the South and the standard steam stations in the North, while maintaining activity in the synthetic manufacture of nitrogenous and organic products.

France Gives Attention to Water Power

The 100-page pamphlet of Rauber and Laborde, entitled "Coup D'Oeil Sur La Production de L'Energie Electricque En France," which appeared last summer, sums up the present status and prospective development of steam and hydro-electric stations in France for the next eight years. From figures given by Rauber it would appear that at least for some years, more than 50 per cent of the electrical output in France will be generated by water power. Nevertheless, the Union d'Electricite is building a new 400,000-kw. station at Vitry-Sud. There will be eight 50,000-kw. turbines and twenty-four Ladd-Belleville three-drum boilers. The fuel will be powdered coal, but a plot of ground has been purchased for a low-temperature carbonization plant adjacent to the power house. The burning of powdered char or semi-coke is contemplated in the future, and the designs of this station show many interesting features.

Much attention is being given the turbine locomotive. At least six firms are offering turbine-driven condensing locomotives, some gear driven, while others have electric drives. Much ingenuity has been expended on mechanical drives and in the design of the surface condensers. Repeat orders from the Argentine Republic, where this type of locomotive on the 500-mile run across the Pampas has been most successful, have lately been received, but the sizes are as yet rather small compared with American practice. Great activity has also been shown in the Diesel locomotive field, particularly in Russia, where oil is cheap and the track gage is larger than the standard 4-ft. 8½-in. gage employed in America and western Europe.

High Pressures for Locomotives

In the steam locomotive field experimentation with higher pressures is the order of the day. The Schmidt locomotive, perhaps the most successful of these designs, and in use on the German Government Railways, was discussed at the December meeting of the A.S.M.E. Another high-pressure locomotive built by the Swiss locomotive Works is in daily use on the Winterthur, Zurich, Romanshorn run in passenger service, a 280-mile run with 26 stops. Work is also proceeding on the Loeffler locomotive at the Vienna Locomotive Works. Experiments are being made with locomotives fired by powdered coal on the German State Railways and a number of these have been undergoing severe tests. A number of builders are working along this line.

Further development of the heavy oil engines of the Diesel, semi-Diesel and solid injection types is progressing. Gasoline, or petrol as it is more generally known in Europe, is high in price, and this fact is responsible for the experiments leading to the adaption of the heavy oil engine to automotive and truck use. At least ten manufacturers are making such engines, and the results are encouraging. These engines, which in design lie between the large marine Diesel and the standard automotive engine using petrol as a fuel, offer savings in cost and

weight over the straight Diesel and a much better efficiency than the usual automotive engine. Diesels fitted with a supercharger are also attracting a great deal of attention and are showing higher efficiency at less weight and cost.

The demand for marine type Diesels from 300 to 6,000 hp. has been excellent, and most Diesel shops have been busy throughout the year. The demand for large Diesels for peak-load purposes in connection with electric power supply continues, but the volume of business is not large. Pavlikovski, at the Cosmos Works, is continuing his experiments with powdered coal as a fuel in the Diesel engine and reports excellent results, especially with brown coal.

Railroad electrification is progressing but slowly. The railroads in Switzerland should be completely electrified by 1930. In Italy progress is limited by the available funds, but a number of new lines were electrified in 1928. In France the preliminary work is proceeding, along with the development of hydro-electric plants in the South and electrification in South Germany, and Austria follows closely the same plan.

Use of High Pressures and Temperatures Increasing

Perhaps the most interesting tendency in European practice for the readers of *Power* lies in the extending use of higher pressures and temperatures in the steam plant. The writer, in a paper before the Mid-West Power Conference last February (printed in *Power,* Feb. 21, 1928), listed all such plants in use or under construction at that date. Since then a number of new plants have been built and orders have been received for additional apparatus. Langerbrugge, however, remains the only high-pressure plant employing 850 deg. F. as the temperature of the steam supply. Pearce, in the new Battersea Station of the London Electricity Supply Company, is buying his boilers guaranteed for 600 lb. and 900 deg. F. total temperature. The boilers will be B. & W. with Taylor stokers. Other operators are considering an increase in the superheat temperature. The high-pressure plant at Bradford should go into service this winter, as the turbine was shipped in October, but only 800 lb. pressure will be used at first. Both Manheim ano Langebrugge have entered repeat orders and Siemens-Schuckert has shipped a 900-lb. turbine for Hanover.

The third Benson boiler has been running for nearly a year; the fifth boiler, installed at the Technical High School at Charlottenburg, has been tested by Professor Josse and the results published in the Z.V.D.I., July 28, 1928. Three more boilers are under construction, the largest for 50 tons of steam per hour. Other manufacturers, Sulzer Bros., Borsig, Hanomag, etc., have orders for boilers running from 600 to 1,600 lb. pressure. Hartman is at work on two indirect boilers for medium high pressures. Witkowitz reports two boilers on the Loeffler system generating steam at 1,600 lb. with a total temperature of about 900 deg. F. A boiler of similar design with a capacity of 50 tons at the same pressure and temperature is under construction. The Erste Brunner Company has constructed a four-barrel tandem turbine of 18,000 kw. for this service. Professor Loeffler reports that his superheater tubes of carbon steel show no signs of trouble or deterioration after 3,000 hours' running at 932 deg. F. It should be noted that these superheaters are welded; they have no expanded joints, and the entire coil is annealed after a completion. The steel is rather high-carbon steel without nickel or chromium, with a tensile strength of about 100,000 lb. per square inch.

Turbine Shops Busy

The turbine shops all over Europe are well filled. The largest machine built up to date is the 160,000-kw. Brown-Boveri & Company machine for the Hell Gate Station of the United Electric Light & Power Company in New York. This machine was shipped early in September and has brought out many comments for the excellence of design and workmanship. Next to this come two 100,000-kva. machines for Golpa (Zchorenwitz). One of these machines is being constructed at Baden by the Brown-Boveri company, while the steam end of the other is made by the Allgemeine Electrizitäts Gesellschaft at Berlin, the generator being furnished by the Siemens-Schuckert Werke at Mulheim.

A number of 65,000-kw. machines and more than twenty 50,000-kw. machines are under order or have been constructed, as well as many smaller machines. Bleeder and back-pressure turbines are much favored and many are under construction. Blading and nozzle vibration and fatigue experiments have been carried on and many new alloys are being tried, notably some electric furnace products which promise well. The largest high-pressure machine is the 7,500-kw. Manheim turbine.

Knoblauch and Koch have just made public the results of their latest researches on the specific heat of superheated steam in the Z.V.D.I. of Dec. 1, 1928. The experimental values run from 300 lb. to approximately 1,800 lb. pressure with temperatures from 400 to 750 deg. F. These results, which have been promised for some time, are greatly needed to check the work of American investigators who have approached specific heat values through another channel, the Joule-Thompson effect. It should soon be possible, on the completion of the work of Doctors Keyes and Smith at the Massachusetts Institute of Technology and the work of Osborne, Stimson and Frock at the Bureau of Standards, to check the whole field of the properties of water vapor from the freezing point to beyond the critical point.

Better Use of Byproduct Heat and Power

Northerners seldom think of the South as having an extensive heating season. Yet an article in the next issue will tell how the University of North Carolina, because of its heating requirements, found it profitable to install a generating unit to serve its power needs, and to use the exhaust steam from this unit to meet the heating load. Thus, through the better use of byproduct heat and power a considerable decrease in the cost of power services was secured.

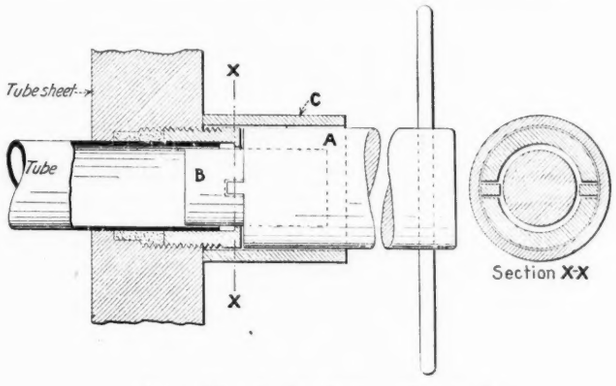
Right Out of the Plant

BOILED-DOWN EXPERIENCE PASSED ALONG TO THOSE WHO MUST SAVE MONEY, IMPROVE THE PRODUCT AND KEEP THE PLANT RUNNING

Practical Tool for Removing Condenser Tube Glands

SOME time ago we had to retube a surface condenser, and when we started the job with the ordinary tool the glands tended to crumble and the tool to slip out of the slot.

To overcome this trouble we made the gland-removing tool illustrated. It consists of three parts, with the part *A* made the same diameter as the outside of the gland.



Assembly of gland-removing tool

The piece *B* is made a sliding fit in the tube, and the sleeve *C* is made to slip over the piece *A* and the gland as shown. The piece *B* is made removable from the part *A* so that should one of the lugs break off the part *A* or need truing up, it can be done more easily than if it were one piece.

This tool greatly facilitated the work and the glands were removed without damage to the slots.

Newark, N. J. C. A. LEONARD.

Increased Steam Pressure Reduced Heating Costs

IN A building equipped with direct and indirect heating coils temperatures between 68 and 72 deg. were insisted upon, and the direct radiation alone could not handle the heating with outside temperatures of 30 deg. or lower. It was customary to start the ventilating fan and blow 85-deg. air into the room as soon as the inside temperature dropped to 68 and to stop the indirect system when 72 deg. was indicated by the thermostat. This thermostat was in the shipping room, which was the hardest room to heat. In cold weather the indirect system had to be used continuously in the forenoon to maintain proper temperatures.

A considerable saving in heating cost could be secured if the indirect heating system were used less frequently. This could be accomplished by installing additional direct radiation, but because of the cost some other means had to be devised.

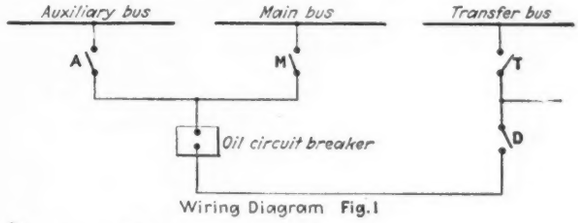
Previously, the radiators were heated by steam at one pound pressure, the condensate being removed by a vacuum pump. The engineer, remembering that all coils had been tested at fifteen pounds per square inch, raised the steam pressure to fifteen pounds. This made the direct radiation about 25 per cent more effective and decreased the operating time of the indirect system to two-thirds of that previously required.

A further gain was made due to the incoming air being heated to 95 deg. because of the increased steam temperature in the coils. Formerly, outdoor air at 30 deg. was raised 55 deg., and with rooms at 68 only a 17-deg. temperature drop was available for heating the room. Increasing the final temperature 10 deg. required 18 per cent more heat per pound of air, but 60 per cent more heat was made available above the room temperature. This reduced the amount of cold air admitted by nearly 50 per cent. In addition to this saving the operation of the vacuum pump was discontinued, and this item, along with reduced fan operations, saved 3,500 kw.-hr. per month, which, at $2\frac{3}{4}$c. per kw., amounted to $96.25. A. F. SHEEHAN.

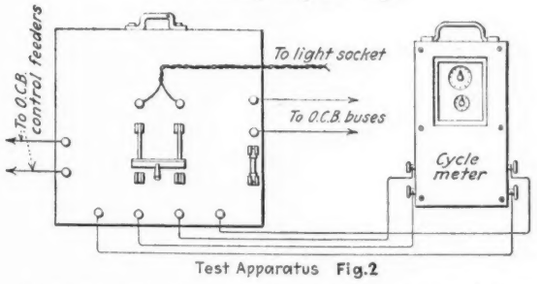
Springfield, Mass.

Testing Oil Circuit Breakers for Speed of Operation

DEPENDABILITY of equipment is most essential to the load dispatchers and control-room operators of both large central power stations and isolated plants. Smooth and rapid operation of the oil circuit breakers must be maintained, and it is the practice in a number of power stations to conduct a simple test of all oil circuit



Wiring Diagram Fig. 1



Test Apparatus Fig. 2

Layout of equipment for testing oil-circuit breakers

breakers every six months. The following test measures the time interval, in terms of cycles, to cut a breaker "in" or "out."

The first step in the conduct of the test is to render the switch dead. With reference to the diagram, Fig. 1, this operation is accomplished by pulling out the main and

auxiliary disconnects at *M* and *A*, and the transfer disconnect at *D* after closing the disconnect at *T*.

As a double precaution the oil circuit breaker is now tested to make certain that it is dead. The contacts of a neon tube are touched to a live terminal to make certain that the tube lights, then against the breaker to be tested, which should not light it, and back against the line to make sure that nothing has happened to the tube during the operation. The oil circuit breaker is now tagged with a danger label stating the cause and time it was taken out of service, and the test is ready to proceed.

The test apparatus consists of a board with single two-pole switch with protecting fuses and a cycle meter. Direct-current control is used for the breaker, while the test apparatus is energized with current from the station light circuit. As shown in Fig. 2, when the switch is thrown the breaker is short-circuited and either trips or closes according to whether the test apparatus is wired for in or out operation. Upon closing the switch on the test board, the cycle meter, which registers the number of cycles completed in the interval of time taken by the switch to operate, immediately starts to register and continues until the breaker opens or closes. The large dial on the cycle meter records the individual test and is set at zero each time the breaker is operated, while the small dial is the totalizer.

Upon completion of the test the warning tag is removed provided the breaker proves satisfactory, and the unit is reported ready for service.

Jersey City, N. J. WALTER W. SLOCUM.

Does the Shaft Deflect?

FROM my personal experience I know that the average man has hard work to understand and appreciate shaft deflections. It is easy to see that there will be a certain shaft deflection when a horizontal-shaft machine is standing still and that the amount of this deflection will depend on the weight of the parts, the size of shaft, the distance between bearings, etc. However, the idea that this shaft deflection does not change, but remains constant as the machine comes up to speed, is mighty hard to get across.

I have found operating and erecting men who were willing to admit that there might be some of the original deflection left, but they all insisted that the spinning of the revolving element must remove the greater part, if not all, of the deflection. One "Doubting Thomas" even went so far as to try to prove he was right. His experience may be of interest.

He had several double-runner horizontal waterwheels direct connected to generators. When overhauling one of the waterwheels, he fitted an iron bracket under the shaft in the middle of the wheel casing. A center-punch mark was made on this bracket directly under the shaft and the distance to the shaft was measured with an inside micrometer setting in this center mark. The generator was then connected to a spare unit, the fields of both generators excited and the spare unit started. Our friend had remained in the open wheel casing with his micrometer and a light. When the combination was running at full speed, he again measured between the punch mark on the bracket and the underside of the shaft. To his great surprise he obtained the same reading as he had at standstill. The deflection was all there, and there was no question about it.

Shaft deflection remains constant as the machine comes up to speed unless its design is such that it runs above its critical speed. If this happens, the shaft deflection changes at the critical speed and takes a different value, which in turn remains constant until the second critical speed is reached, when a third deflection appears. Fortunately for our peace of mind, we rarely have to consider the question of critical speed and there is only the first, or standstill, deflection to be taken into account when we have to couple two or more machines together.

N. L. REA,
Schenectady, N. Y. General Electric Company.

Repairing a Piston Head

THE illustration shows the repairs made to the piston head of a Deisel engine, which worked out successfully.

In 1920 a 450-hp. unit, consisting of two three-cylinder Type A Busch-Sulzer Diesels with a generator between, was installed in the San Pedro de Macoris, Santo Domingo, light plant. These engines had been built in 1907 and had been in service in a New England rope factory.

The piston after repair

Recently, a crack developed in the crown of one of the pistons. A new piston was ordered from the factory, but it was necessary to keep the unit in service during the two months' wait for the part.

The crack opened up and the flames started blowing through to such an extent that a one-inch hole was burned completely through the metal.

The piston was repaired by machining a recess in the crown, into which a steel plate was placed and fastened by machine screws, as shown in the illustration.

The piston was put back into service and has operated continuously for over two months. H. KENNISON.

Santo Domingo City, R. D.

Draft tips installed in the furnace for use in measuring the draft in the combustion chamber have a habit of becoming clogged with cinders. If a tee and valve are installed in the pipe between the boiler and the draft-gage shutoff valve, the tip may be cleaned without taking it from the boiler by attaching a compressed-air hose at the tee and blowing the cinder accumulation out into the furnace. Care must be taken to shut off the valve at the draft gage to prevent injuring the instrument.

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES

Oil Cooler with Integral Connections

IN THE oil cooler illustrated the shell, channel box and all connections are cast integral and the lines leading to or from the unit, either in the oil or cooling water, need not be disturbed to allow removal of the nest of tubes. It is only necessary to remove the head *A* to permit the nest

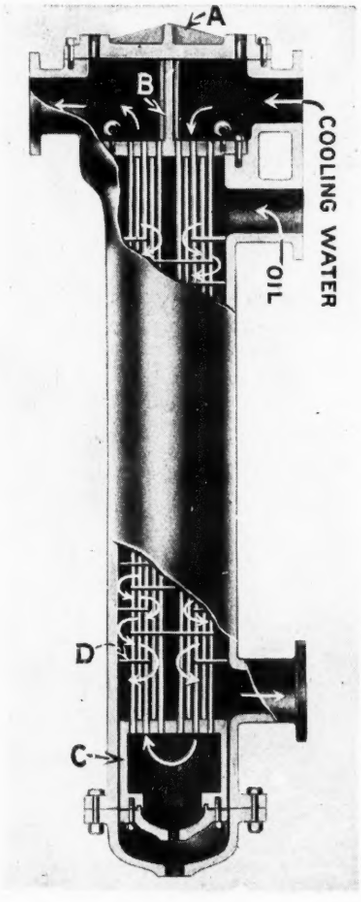


Fig. 1—Cut-away view of cooler showing constructional details and baffle arrangement

to be readily withdrawn from the shell, eyebolts being provided in the tube sheet for this purpose.

Both shell and chamber are bored to size. The tube sheet and dividing rib *B* are cast integral and set in a recess. The floating chamber *C* is machined to a sliding fit in the shell, and all internal gaskets are confined in grooves to prevent blowing. The shell baffles *D*, which deflect the oil back and forth across the tubes, are machined to fit the bore of the shell and all tubes are rolled into grooves in the tube sheets. As indicated by the arrows, the baffle arrangement and flow provide a unit in which counterflow is combined with cross-flow. The oil flows through the shell directed in its path by baffles, while the cooling water flows through the tubes, making two passages across the length of the shell.

Provision is made in the design of the cooler to permit the tubes to be tested readily for tightness in the tube sheet with the heads removed. The face of the floating chamber *C* and the shell are flush. This permits the use of the ring test flange, Fig. 2, provided with the cooler, allowing

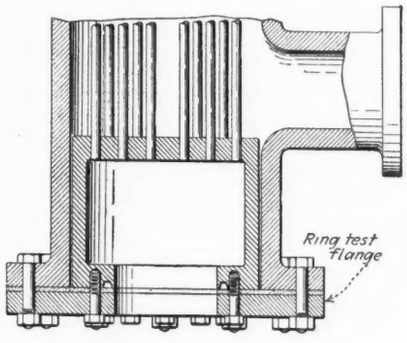


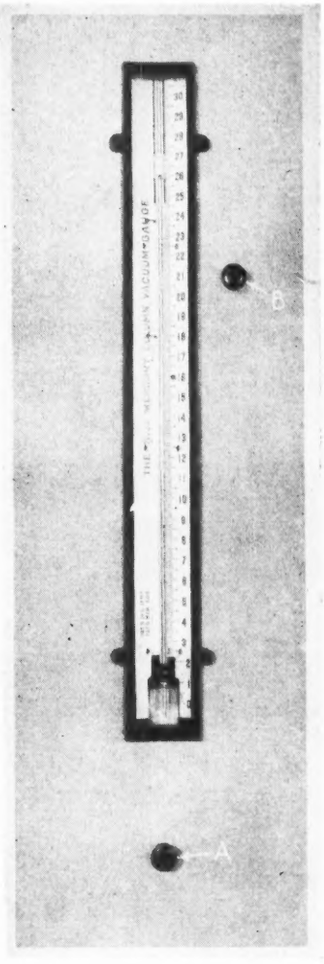
Fig. 2—Application of ring flange for testing purposes

the ends of the tubes to be visible while pressure is maintained in the shell. The joint between the floating chamber and its cover is made tight by placing the gasket in a groove or recess in the chamber, into which a tongue, which is part of the cover, fits. No connection is made between the floating chamber and the shell. The shells and chambers are made of cast iron or steel, the tubes are $\frac{5}{8}$-in. O.D. Admiralty metal or steel and the baffles and tube sheets bronze or steel.

It is pointed out by the manufacturer, the O. E. Frank Heater & Engineering Company, Inc., Buffalo, N. Y., that owing to the fact that the tubes are rolled and expanded into solid metal tube sheets, the coolers may be used for temperatures up to 1,200 degrees.

Flush Mounted Mercury-Column Vacuum Gage

TO MAKE the mercury-column vacuum gage suitable for flush mounting, the Taylor Instrument Companies, Rochester, N. Y., have brought out the model illustrated. The body of the instrument is set



Vacuum gage mounted on panel

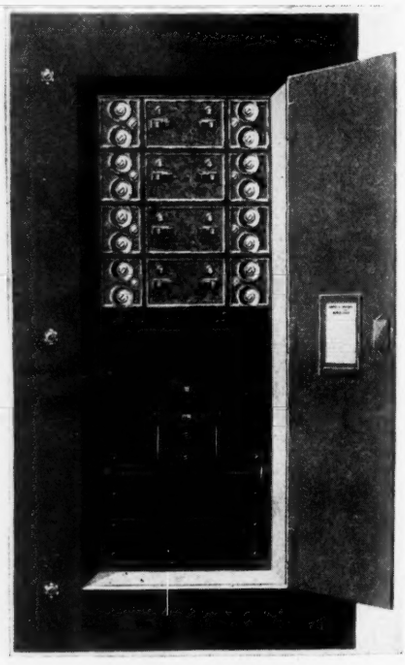
back of the panel with the face flush mounted.

As it is necessary on gages of this type to set the zero before taking a reading, a knurled knob is provided at the bottom of the instrument, as at *A*, by means of which the cistern can be raised or lowered to make a correct zero setting. The knob *B* at the upper right-hand side of the gage

operates the vernier, and an engraved thermometer is mounted on the scale to indicate the temperature of the mercury column. The gage can be furnished with or without a vernier, as desired.

Panelboards Have Molded Bakelite Parts

A NEW line of panelboards, lighter and less bulky than former types, was recently announced by the Square D Company, Detroit, Mich. Bakelite is used for all molded parts.



Door of cabinet open to show panelboard

These include adapting units, sectional base, switch covers, switch handles, supporting blocks and blank sections. Circuits also are designated by Bakelite numbering buttons.

New design has been employed in the main switches of 60-, 100-, and 200-ampere capacity. These are of an improved brush type, with exceptionally quick break. Tumbler switches are 30-ampere 250-volt rating, of the heavy-duty type, easily removable from the front. Brush switches are of 250-volt rating heavy-duty type. All metal parts are rustproof.

Plug fuses and cartridge fuses are interchangeable. It is necessary only to remove the plug-fuse section and replace it with one designed to hold cartridge fuses. This may be accomplished without removing the panel from the cabinet, a feature of advantage to industrial users. Fronts or trims are easily mounted, using an indicating adjustable clamp and rest-plate, spot-welded to the inside of the service trim.

Many safety features have been incorporated in these panelboards. No steel covers are used around branch fuses or tumbler switches. When main switches or fuses only in sub-feeds are used, they are under separate locked steel covers. The new panelboards are a complete line, meeting every requirement of industrial service.

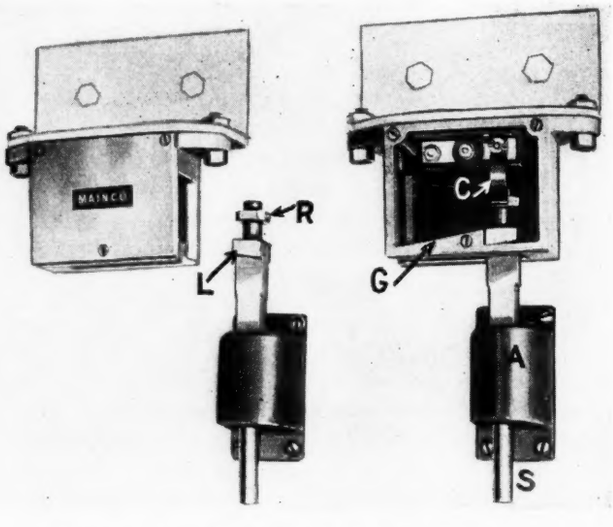
Combination Lock and Contact for Elevator Doors

THE lock and contacts on elevator hoistway doors should be so designed that the doors are locked before the contacts make to allow starting the car. These requirements are met in the new combination bar lock and contact placed on the market by the Maintenance Company, Inc., 449 West 42nd St., New York City.

As shown in the figure, on the top end of the locking bar is an insulated ring *R* that passes in between contacts *C* when the door is closed. The contacts are curved in such a way that the insulated ring cannot complete the contact circuit until the locking bar drops into the locked position, as shown at the right in the figure. Contact is made by a wiping action, insuring that the circuit will be completed when the doors are closed and locked.

Near the top of the locking bar is a wedge shaped lip *L* that rides up on the guide *G* as the door approaches the closed position. When the door is completely closed, the lip *L* drops in behind the guide and locks the door in the closed position and at the same time completes the control circuit. Part *A* is a guide for the upper end of the locking bar and is attached near the top of the hoistway door. An extension bar coupled to the stem *S* brings the locking bar within easy reach of the operator.

These combination bar locks and contacts are supplied for either sliding or swinging doors, complete with extension bars and guide brackets.



Complete and partial assembly of door lock and contact

Threadless Thin-Wall Electric Conduit

A NEW kind of conduit for electrical wireways has been announced by the Electrical Division of Steel and Tubes, Inc., Cleveland, Ohio, a subsidiary of the Republic Iron & Steel Company. This new product is known under the 1928 Electrical Code as "electrical metallic tubing."

"Steeltubes" electrical metallic tubing is a thin-walled rigid conduit having the characteristics of so-called heavy, standard conduit but lighter in weight. It is made from cold-rolled open-hearth steel, which provides a tube ductile enough to be bent readily to any desired shape by the use of a special bending hickey supplied by the manufacturer.

The wall of this conduit is approximately one-third the thickness of standard conduit. It is used without threading, connections being made by

means of a union compression-type coupling. Part of this coupling may be used as an adapter to connect the conduit to standard threaded or threadless fitting.

It is supplied in ten-foot lengths, one union-type coupling given free with each length, and is available in one-half, three-fourths and one-inch electrical trade sizes, with the same inside diameter as heavy-wall conduit. The exterior is electrogalvanized, and the inside is coated with baked enamel.

Advantages claimed for the new material: There is no thread cutting, it is easy to work with on the job, easy to handle because of its lighter weight and can be used with any threaded or threadless fittings, and is low in cost.

Device for Eliminating Pipe-Line Vibration

THE illustrations show a stabilizer designed to prevent the vibration in pipe lines, recently introduced in Europe by the Sulzer Bros., Winterthur, Switzerland.

The apparatus consists essentially

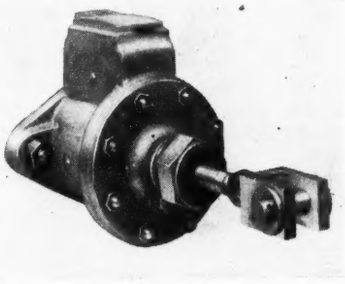
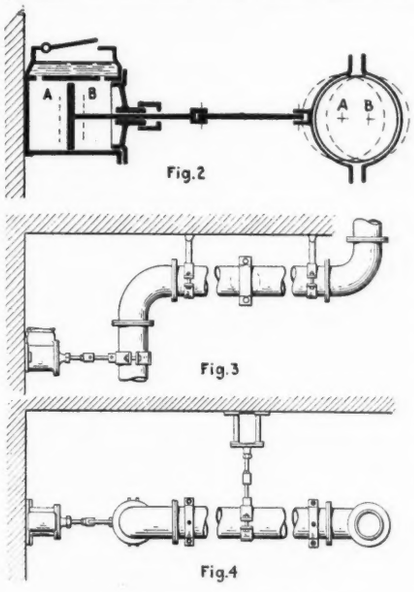


Fig. 1—Stabilizer unit

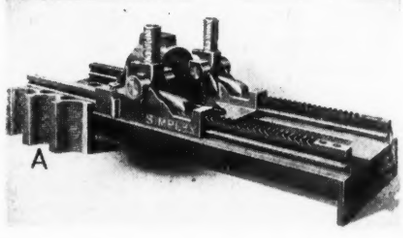
of two parts, a fixed part comprising a cast-iron cylinder which is bolted or secured to a wall or other fixed support, and a movable piston to which are connected a suitable piston rod, link and pipe clamp. The length of the movable part is readily adjusted by a fork screwed to the piston rod. The device is usually fitted between two fixed parts of the pipe, as shown in Figs. 3 and 4. The cylinder has an oil well closed by a lid and fitted with small passages to either side of the piston. The sizes of the passages are such as to provide a damping effect on the movements of the piston.

Referring to the diagram, Fig. 2, assuming that the pipe is in an undamped state, the possible vibration of the pipe and the piston in the stabilizer is indicated by the dotted lines *A* and *B*. Owing, however, to the presence of oil a damping action takes place. The oil is forced out through the small rear passage into the well when the movement of the piston is toward the wall, and an



Figs. 2, 3 and 4 — Diagram of stabilizer and typical installation on pipe line

equal amount of oil to that displaced enters by the other passage to the front side of the piston. Similarly, the outward movement of the pipe is damped by oil being squeezed through the front passage in the well. The succession of these vibrations is rapid, and in practice a small displacement of oil from one side of the piston to the other takes place, and the movement of the pipe is reduced to within safe limits.



Jack with set of tapered pipe-gripping jaws

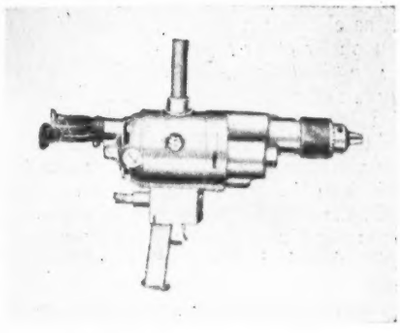
Simple Pipe-Pushing Jacks

AN IMPROVED type of jack for pushing pipe through earth under roadways, railroad tracks and other similar locations to obviate excavating, has been brought out by the Templeton, Kenly & Company, Ltd., Chicago, Ill.

The jack is fitted with three tapered jaws as at *A*, one set for each size of pipe, designed to give a gripping surface completely around the pipe and thus obviate any tendency to flatten it. The duplex levers, one on each side of the pipe, can be operated singly, alternately or together, depending upon the size of the pipe, soil condition, etc. The length of travel at each setting is 25 inches.

In operation, after the pipe has been pushed by the jacks in the soil approximately 25 in., the tapered jaws are released by tapping the releasing block with a hammer, then the carriage pawl mechanism is slid back to the opposite end of the ways and reclamped to the pipe.

The jack is made in two sizes, No. 332 for pipe from $\frac{3}{4}$ to 2-in. and the No. 334 for pipe from 2- to 4-in. Simplex steel pilots for screwing on the end of the pipe can be furnished with the jacks if desired.



Heavy-duty $\frac{3}{4}$-in. drill

Light-Weight Heavy-Duty Electric Drill

THE light-weight, heavy-duty electric drill illustrated is designed for a load speed of 350 r.p.m. with a $\frac{3}{4}$-in. drill. It is powered by a universal motor, and ball bearings are used throughout. The speed-reduction gears are hardened chrome nickel steel completely inclosed in a grease-filled casing.

The drill has a one-piece aluminum body frame and commutator head and is fitted with a quick make-and-break two-pole trigger switch and a three-jaw screw-back chuck for straight shank drills. The total weight is 27 lb. The drill is manufactured by the United States Electrical Tool Company, Cincinnati, Ohio.

Research Agencies in the United States

By A. A. Potter
Dean of Engineering, Purdue University

RESEARCH is carried on in industrial laboratories, in commercial testing laboratories, by engineering societies, in educational institutions, in special research institutes and in government bureaus and departments.

Among the industrials that are devoting large sums to research are the General Electric Company, the Westinghouse Electric & Manufacturing Company, the American Telephone & Telegraph Company, the Eastman Kodak Company, the United States Steel Corporation and several firms prominent in the chemical and automotive industries. In the power field many of the progressive electric utilities are carrying on studies which may also be classed as engineering research.

There are a number of private commercial laboratories which investigate materials, check products and carry on studies ordinarily classed as research.

Several of the national engineering societies, through special committees, are carrying on research. However, only the American Society of Heating and Ventilating Engineers and the American Gas Association maintain special laboratories. The other societies act as clearing houses for research carried on by other agencies.

The investigations of the U. S. Bureau of Standards, the U. S. Bureau of Mines, the U. S. Geologic Survey and the U. S. Naval Experiment Station at Annapolis, are of particular value to American industries and utilities.

Of the special research institutes the Mellon Institute of Industrial Research, at Pittsburgh, is the pioneer and leader. While most of the studies carried on by the Mellon Institute are concerned with the applications of chemistry, the investigations of this agency on pipe covering are of particular interest to the power industry.

Research work at universities and in engineering colleges have the following advantages as compared with problems solved in laboratories of industry:

The research worker in an educational institution is working in an atmosphere that is sympathetic to the creation of new knowledge, he is more free from interruptions, and his work reacts beneficially in improving the main product of educational institutions—the students who are being trained for industry. Industry needs engineers who will extend the frontiers of knowledge and who will develop new processes for the conservation of our resources and for the elimination of waste. Progress depends upon men with initiative. Industry is placing a premium upon those who have ability to take the lead, to plan, and to originate. Initiative can best be developed in college students if they are brought into contact with teachers and investigators who are interested in taking new paths, in trying new experiments and in adding to knowledge. This can be accomplished if the power plants and other industries will bring more of their research problems to engineering colleges. While the larger industries may find that most of their problems must be solved in their own laboratories, they must realize that their efforts will not bring profitable results unless educational institutions are finding and developing for their research staffs students who have ability to create new knowledge.

That research is not being neglected by engineering colleges is evident from the November, 1928, report of the Committee on Engineering Experiment Stations of the Association of Land Grant Colleges and Universities.[1] This report states that 35 land grant institutions have organized engineering experiment stations for carrying on research; that these stations are spending during the present year over $1,396,000 for research, are employing 393 full-time and 265 part-time research specialists. They have published up to date 677 bulletins. Of the total sum mentioned, over $723,000 was contributed by industries or utilities who are co-operating with these institutions in research. A number of engineering colleges not in the land college group are also carrying on tests, experiments and investigations of value to industry. The total expended for research at all of the engineering colleges in the United States is probably about two million dollars per year.

[1]The term "Land Grant Colleges and Universities" is applied to institutions that operate under the Federal Land Grant Act of 1862. There is one land grant college in every state operated either as a part of a state university or as a separate technical institution. Practically every land grant college teaches engineering.

[In the Feb. 5 issue Professor Potter will discuss what is going on in fuel research.—Editor.]

Recent Publications

Electric Drive Practice. By Gordon Fox. Published by McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City, and 6 Bouverie St., E.C. 4, London, England, 1928. Cloth; 6x8 in.; 60 tables; 170 illustrations; 421 pages. Price, $3.50.

THIS book is a companion volume to the author's previous work, "Principles of Electric Motors and Control." The initial volume dealt chiefly with the fundamentals of motors and controllers, while this one is devoted to their application to machinery in industry. The treatment is from the practical rather than the theoretical point of view. Mathematics has been included to a limited extent, where necessary to application problems. Many of the data are presented in tables and curves for ready use.

The text is divided into seventeen chapters. The first five deal with advantages of motor drives, factors governing the selection and application of motors, selecting control equipment, mechanical features of motor installations, electrical features of motor installations. Specific motor applications are treated in the last twelve chapters. These include applying motors to fans, blowers, air and ammonia compressors, pumps, cranes, elevating and conveying equipment, hoists, elevators, machine tools, and industrial electric traction.

Each class of machine is discussed as a premise to selecting the proper motor. The elements of load are evaluated and the factors affecting the load and the motor size determination. The functions that the machines perform, the laws governing their action and their peculiar requirements are enumerated.

A valuable part of the treatment is the many tables. These give data on both motors and driven machines. One of these tables lists the different types of motors and gives their speed characteristics, their maximum torque, the starting duty they are suited for and the kind of drives to which they are adapted. Another table gives a summary of the National Board of Fire Underwriters Code Rules for motor wiring, cutouts and circuit breakers.

The author has succeeded in compiling a mass of practical information on electric-motor applications and has presented it in a convenient and easily comprehended form.

Employment Fluctuations in Pennsylvania, 1921 to 1927. By J. Frederick Dewhurst. Special bulletin No. 24 of the Department of Labor and Industry, Commonwealth of Pennsylvania. 192 pages.

THIS bulletin is the result of several years' study of the employment situation in Pennsylvania. Its purpose, to quote the author, is "to discover and present the facts contained in the employment data in such a way as to provide indexes which give a continuous measurement of the changing levels of employment and payrolls in this region and in particular industries of the state. The result of this effort, if successful, should be of significance to students of business conditions and social and economic investigators in Pennsylvania, as well as in other industrial areas of the country, for the underlying methods described in this thesis, it is believed, are flexible enough to be applied to the analysis of similar data in other regions." After a short chapter on "Employment as a Measure of Economic Conditions," the bulletin deals at length with the methods used in collecting and organizing the information, and with the construction of a comprehensive set of "index numbers."

FROM AMONG THE READERS' PROBLEMS

Conducted
By
L. H. Morrison

BAROMETRIC CONDENSER FLOODS ENGINE.—*Our 24x48-in. engine is served by a barometric condenser. At certain times the condenser has apparently let water pull over to the engine. Is this action possible?* W. J. R.

It must be admitted that, although the behavior is contrary to accepted laws, it is possible for such a condenser to pull water over into the cylinder of the engine.

Assume that the engine has been stopped and that the flow of water to the condenser head has been shut off. The column of water in the down pipe is supported by the pressure of the atmosphere on the outside. Now if the tail pipe is not buried deeply in the tailrace, the atmospheric pressure may push down the level of the water immediately around the pipe to such a point that air bubbles will escape into the tail pipe, and will rise up into the head. These rising bubbles will lower the weight per foot of the water in the tail pipe just as is the action in a water lift pump. This decreased weight of water means that the atmospheric pressure will support a higher column of it, and water is backed up from the tailrace into the tail pipe until the water level reaches the connection to the engine, and it will naturally flow over by gravity through the exhaust connection into the cylinder. This action can hardly happen while the plant is in operation, but obviously it can if the plant has just shut down.

The remedy is to bury the discharge down pipe into the tailrace so that its end is covered by two or three feet of water.

TUBE THICKNESS OF WATER TUBE BOILER.—*In our boilers the lower rows of tubes are of a heavier gage than those in the upper rows. Why is this done?* A. C. L.

The lower tubes are subjected to greater temperatures, and while the thicker walls cause a greater temperature gradient, they give greater strength. In case of a blister a thin tube might be drawn out so thin as to let go and rupture the whole length of the tube. With a thicker wall the blister would probably be more localized, and only a small pinhole rupture would occur.

CAUSE OF SAFETY VALVE RUMBLING—*What causes a safety valve to rumble, and how can it be remedied without redesigning the valve?* C. B. S.

Before answering this intelligently, it will be necessary to elaborate upon what is meant by rumbling. A valve may clatter, owing to the fact that the blowdown ring is so adjusted that the boiler is not relieved enough when it does open, and after blowing a small amount the valve goes closed, and immediately the boiler pressure causes it to rise again. This clattering can be remedied by adjusting the blowdown ring so that the boiler pressure drops several pounds before the valve reseats. If by rumbling is meant a hissing sound before the valve opens, this is due to the design of the valve, but it may be partly remedied by adjusting the blowdown ring on the valve so that as soon as the valve starts to open, the blowdown ring will hold the steam inside of the huddling chamber sufficiently to build the pressure up enough to raise the valve instantly, rather than just barely leave its seat and hiss.

EARLY CUTOFF WITH THE D SLIDE VALVE.—*What is the earliest cutoff one can have with a D slide valve on an ordinary engine?* J. S.

One can obtain as early a cutoff as desired with a D slide valve, and automatic shaft governor engines are built for attachment to D slide valves when the valve is balanced enough to reduce the friction to a point where the governor can handle the valve. Consequently, you can have as early a cutoff as you desire.

However, if the question had been, "What is the earliest cutoff obtainable with a common D slide valve used on a throttling governor engine?" the answer would have been different. It is customary to have such a valve cut off at not earlier than five-eighths stroke, and generally it is set to cut off at three-quarters stroke. The reason for this is that, with the fixed eccentric, cutoff never can occur later than that predetermined by the designer. As a consequence, if a load were too heavy for the engine to carry with the predetermined cutoff, then the engine would have to stop because not enough steam could be admitted to the cylinder to carry the load. For light loads, the throttle governor itself would reduce the steam pressure so that the engine speed would be held constant.

COMPARATIVE EFFICIENCIES OF UNIFLOW AND COUNTERFLOW ENGINES.—*Can the uniflow engine be used as efficiently as the counterflow engine when all of the exhaust is used for heating in a factory?* R. B. S.

Broadly speaking, the engine that will deliver the most horsepower when passing a certain weight of steam from a given initial pressure to a given back pressure, is the more efficient. On this assumption the uniflow engine will ordinarily prove to be more efficient than the counterflow. This, of course, contemplates that the uniflow engine is provided with either the necessary clearance volume or auxiliary exhaust valves to prevent the back pressure from going above the initial pressure. In many cases a counterflow engine may prove more efficient than some particular uniflow engine, by reason of the fact that the increased clearance volume in the uniflow engine, when operating against a high back pressure, causes initial condensation losses that offset the thermal advantages that the uniflow principle may have.

BOILER TUBE FERRULES.—*Why are some boilers fitted with copper ferrules around the tube end? Do they provide for the expansion of the tubes when under pressure?* C. L. W.

Ferrules are used on steam boiler tubes to correct the defects. In case a tube hole becomes so enlarged by rerolling of tubes that it is too large for the new tube, it is customary to insert a thimble or ferrule so that the tube need not be rolled to so great an extent to make a tight joint as would be necessary if the thimble were not used.

A Question For Our Readers

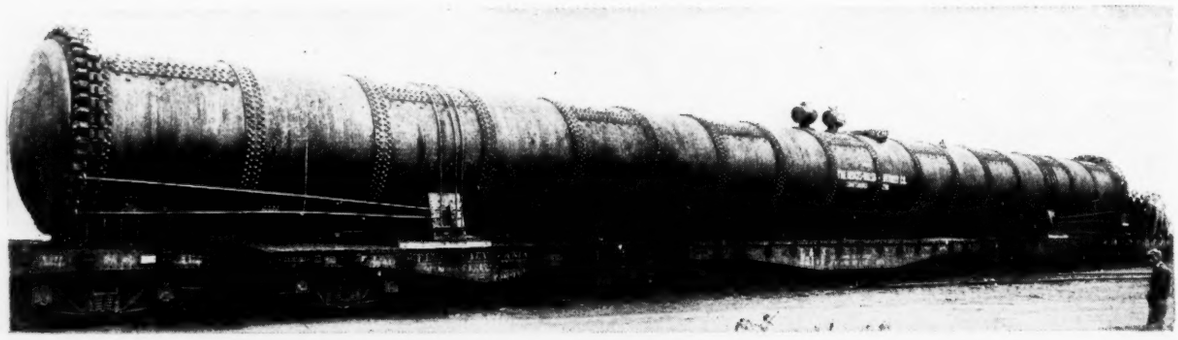
I AM confronted with the task of computing the amount of coal in an irregular storage pile. I have no definite idea of how to attack the problem. What is the most practical way to measure this coal?

W. B. D.

Suitable answers from readers will be paid for and published in the Jan. 31 issue.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE



IF it were not for the imposing rows of rivets, this steel drum might be taken for a smokestack en route to some large power station. Instead, it is a huge tank to be used for pressure creosoting, and was recently turned out by the Hedges-Walsh-Weidner unit of the Combustion Engineering Corporation. The tank measures 140 ft. overall. Note that two of the five flat cars alone provide the two-point support necessary to make turning possible.

World's Largest Water Project Authorized by President

Boulder Dam Bill now Delayed only by Legal and Engineering Details

THE President on Dec. 21 affixed his signature to the Boulder Dam bill, which authorized the expenditure of $165,000,000 for the construction of a high dam in the Colorado River at Black Canyon.

The act authorizes the Secretary of the Interior to construct, operate and maintain (1) a dam at Boulder or Black Canyon, sufficient to store not less than 20,000,000 acre-feet; (2) a main canal to supply water to the Imperial and Coachella Valleys in California; (3) the Secretary is authorized to construct or cause to be constructed at or near the dam, a power plant and incidental structures.

The act contains the principal features of the recommendations of the Bureau of Reclamation. The site is that which the Bureau recommended, the capacity of the reservoir was fixed at that worked out by the engineers of the Bureau. It also was their suggestion that the power revenue be applied on the capital expenditures by the government. The bill includes the all-American canal which is to be built and paid for under the provisions of the reclamation law. The original recommendation that construction be undertaken on approval of six or seven basin states also came from the Bureau.

The amendments to the bill are regarded as helpful. This applies particularly to the conditional contribution of $25,000,000 of federal funds for flood control, as does the arrangement for payment to Arizona and Nevada to take the place of taxes. The belief among Reclamation Bureau engineers still is that the cost can be held below the amount estimated by the Sibert Board.

At least a year must pass before construction can be begun. It is believed that length of time will be required for ratification of the preliminary surveys and to handle the competitive bidding for the power. It is expected that $50,000 will be carried in the second deficiency bill to take care of preliminary studies and the preparation of plans which can go forward in the meantime.

The steps for carrying out the development have been outlined by the Bureau of Reclamation as follows:

1. Ratification by the Colorado Compact.
2. Preparation of plans and estimates for the dam and power house.
3. Contracts for power revenues.
4. Building of the dam by the government, and building of the power house either by the government or by private parties.
5. Building of the all-American canal from the headgate down to the International boundary.
6. Building the remainder of the canal if satisfactory agreement with Mexico cannot be secured or if the irrigation interests that are to pay for this canal desire it to be constructed and enter into a satisfactory contract which will assure the payment of the costs.

Water stored in the reservoir shall be used, first, for river regulation, improvement of navigation and flood control; second, for irrigation and domestic uses; and third, for power.

Before the dam can be begun or contracts made for the power house, the offers for power must be large enough to repay within fifty years the money spent by the government, with 4 per cent interest, less the $25,000,000 flood control item, if such contracts are secured. If the Imperial and Coachella Valleys are prepared to repay the entire cost of the all-American conal, contract for that canal also could be let.

1929

Today, on the first of January, 1929, *Power* prints nothing but "last year's" news. Tomorrow, the things that happened in 1928 will be old stuff, and we shall be full in the swing of another year in which *Power's* News Section plans to give you a snappier, more vital and better illustrated record of the things that will be going on in our field. Watch *Power* in

1929

Annual Chemical Industries Exposition Announced

THE Twelfth Exposition of Chemical Industries will be held at the Grand Central Palace, New York City, during the week of May 6 to 11, 1929.

The Exposition draws together chemists, engineers, manufacturers and others interested from forty industries which are dependent in their operations upon a chemical change in the nature of the material or are under chemical control. These industries include byproduct coke ovens, gas and public-utilities companies, plastics manufacturers, petroleum refiners, and many others.

A particular study recently made of 20 of these industries shows that they alone produce 17 per cent of all the products manufactured in the United States and employ 22.6 per cent of the total capital invested in manufacturing. They have over two million electric motors installed, consuming over six million kilowatt-hours of electrical energy. In this use of electricity they rank second in America. These industries also consume over 98 million tons of coal per year, occupying first place in this respect.

The Exposition of Chemical Industries brings together between 350 and 450 exhibitors, displaying products that include the varied types of chemical engineering equipment and processes and special machinery as used in the many chemical industries. It embraces in this wide range of exhibits apparatus for precise measurement of pressure, volume, flow, temperature and time; laboratory apparatus, supplies, chemicals, etc.; the raw materials used in all the chemical industries; and the chemicals, dyestuffs, technical materials, and chemical products which are applied in the industries and arts.

As heretofore, there will be in the Exposition a special section for laboratory equipment, a Southern Section, and a Canadian Section, in the last two of which maps and charts will demonstrate the natural facilities and power resources attractive to new industries. Railroad companies and state governments are also among these exhibitors.

The Students' course of lectures which has been an institution in the past Expositions, will be repeated again, in the charge of Dr. W. T. Read, professor of chemistry from Texas Technological College.

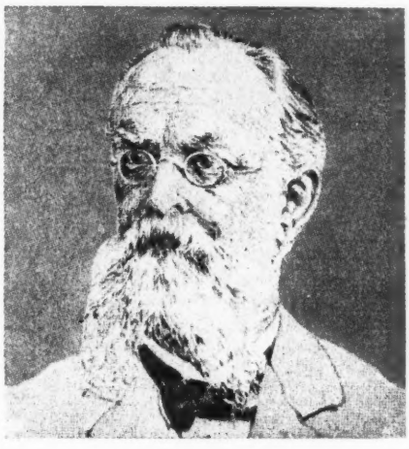
School to Hold Open House

The Brooklyn, N. Y., Polytechnic Institute announces that it will hold open house during the afternoon and evening of Jan. 11, for the purpose of demonstrating its laboratory facilities. The chemical, civil, electrical and mechanical engineering laboratories and shops will be in full operation at this time. The exhibition will include demonstrations in chemical manufacture, radio communication, high-voltage display, X-ray work, automobile and airplane engines, industrial gas equipment, hydraulic machinery, and numerous other interesting experiments. The Institute is exceptionally well equipped for carrying on an engineering curriculum, and the open house is to be held with the object of acquainting the public with these facilities.

A motion picture, "Opportunity," portraying the four large fields of engineering, civil, electrical, mechanical and chemical, will be shown during the program.

Gustav Zeuner Centenary

The one hundredth anniversary of the birth of Gustav Zeuner was fittingly observed, on Nov. 30, 1928, at the Dresden, Germany, Technical University in the presence of many internationally prominent engineers, scientists



Gustav Zeuner

and teachers. Professor Zeuner was one of the world's greatest authorities on thermodynamics, and in early collaboration with Weisbach, Regnault and Clausius, was a pioneer in modern steam engineering. He was the author of many books and treatises based on research in diversified engineering subjects. He was responsible for the Zeuner valve diagram, which is extensively employed in engine design.

Smelting Company Starts Power Project

Orders have been placed for the equipment to be installed in both the temporary and permanent power plants of the Hudson Bay Mining & Smelting Company, at Island Falls, on the Churchill River, in the province of Saskatchewan, Canada. The temporary power house will contain two 1,040-hp. hydro-electric units that will supply power for the construction of the permanent generating station, which will have an initial installation of three 15,000-hp. units under a 49-ft. head.

The main units will be of the propeller type, rated at 15,000 hp. at 163.6 r.p.m. and will drive Canadian General Electric vertical generators of 12,000-kva. capacity. When the permanent plant is in operation, the smaller units will be transferred to it and used as auxiliary machines.

Hydro Projects in Scotland

TWO bills are now before the British Parliament advocating the development of the water-power resources of Scotland, in Galloway and the West Highlands respectively.

The Galloway scheme proposes to utilize the power resources of about 400 square miles of the watershed of the River Dee in the south of Scotland. The total available power is not concentrated at one spot, and its efficient development, therefore, involves the construction of a number of small stations, which have been so arranged that the water discharged from the upper stations can be utilized successively by the lower stations, together with the water collected from the lower catchment areas. The largest of the proposed developments will be the Tongland station at the mouth of the Dee, not far from Kircudbright. This station will contain machinery of 48,000 hp. A second power station will be located near Glencoe, with the comparatively high head of about 400 ft. Two further sites, with available heads of about 70 ft., will be developed. The fifth and uppermost power station will be placed near the junction of the waters of Deugh and Ken, and will operate under a gross head of about 170 ft. The multiple station plan has been rendered capable of economical development by the utilization of a number of favorable storage sites.

The other power site, which is in the West Highlands, is based on Loch Quoich in Inverness-shire, which is to be made the storage basin of an area of about 200 square miles in one of the wettest regions of the Highlands. By leading the water by a tunnel down to sea level at the head of Loch Hourn, the engineers will have obtained at once a head of nearly 600 ft., and a site for the chief power station accessible to ocean transportation, where electrochemical and electrometallurgical factories and works can conveniently be constructed. A separate and smaller power station is also proposed in this development, and the whole project will have a continuous output capacity of 50,000 horsepower.

Toledo Edison to Expand

The Toledo Edison Company plans to spend $3,000,000 in Toledo, Ohio, and vicinity for its 1929 expansion program, C. L. Proctor, vice-president and general manager, has just announced. The biggest item, which will involve expenditure of $1,500,000, will be a new turbine-generator to be installed at the Acme power plant. This unit will be delivered about Jan. 15, will be ready for use on or before April 1, and will increase the capacity of the Acme plant to more than 110,000 kw. This plant serves the business and industrial section, an area that continually is demanding more power.

Spot * News

FIFTEEN HUNDRED MEN *are at work at the lower dam site at Fifteen-Mile Falls on the Connecticut River in Vermont. Four units aggregating 120,000 kw. are expected to be ready for service in this plant by September next.*

* * *

ENGINEERS *of the General Electric Company at Harrison, N. J., seem to have discovered a use for the world's most useless byproduct—escaping steam. A plume of it 200 ft. high, rising from the plant in the winter air, has been turned into a pillar of Christmas fire and a sign of the new year, with the aid of 24,000,000 candlepower of colored light, projected upon the plume at night. It is said to be visible ten miles.*

* * *

THE CAPACITY *of the power plant of the Texas-Louisiana Power Company at Pecos, Texas, is to be doubled at a cost of about $500,000. Its present capacity is about 2,500 hp.*

* * *

A HOLE *1,300 ft. more than a mile deep, is to be pushed 2,000 ft. farther toward the center of the earth by electric power in the Big Lake oil field in Texas. A world's record for depth is being sought, along with the gas and oil which it is hoped are hidden at the great depth of 8,500 feet.*

* * *

ALBANY, N. Y., *is to relinquish its almost unique position among large cities as a user of 40-cycle electric current. The New York Power & Light Corporation, which serves the city, announces that a change will be made during 1929 to 60 cycles. This change in frequency will involve appliances in 35,000 homes, and more than 100,000 machines in industrial use.*

* * *

AN EXPERIMENT *is being conducted at Fort Wayne, Ind., by the General Electric and the Johns-Manville companies, in the heating of private residences by electricity. General Electric is furnishing the heat with special appliances, and Johns-Manville rock wool and asbestos insulation is preventing the valuable B.t.u.'s from escaping. Seven rooms and a bath, they say, can be kept warm all winter for $210!*

B. C. Interests to Enter Coal Processing Field

Large-scale development of the enormous coal fields around Telkwa, B. C., are foreshadowed in the statement that British interests, said to be backed by the Mond group, of which Lord Melchett is the head, were behind the recent Telkwa colliery sale.

Plans of the purchasers, which are stated to have been made known in Victoria, B. C., contemplate the erection of large plans for the utilization of the Bussey low-temperature carbonization process for the manufacture of coal into many commercial products, after the extent of the coal holdings around Telkwa have been determined. This gigantic undertaking is designed to utilize British Columbia coal for the first time in a big way for the manufacture of byproducts. The Telkwa and Copper River coals, it is stated, have been tested and found peculiarly valuable in the production of petroleum, tar, ammonia and coke.

With the Society Sections

American Engineering Council, annual meeting, to be held in Washington, D. C., Jan. 14-15, 1929, at the Mayflower Hotel.

A. S. M. E., Knoxville Regional Meeting, Mar. 21-23, 1929. Technical program and trips to points of interest.

United Engineering Society, dinner, in New York City, Jan. 7, 1929, for the purpose of receiving the report of the committee on war memorial to American engineers, on the Louvain carillon and clock.

American Water Works Association, Kentucky-Tennessee Section. Annual meeting, to be held at Chattanooga, Tenn., Jan. 24-26, 1929.

National Marine Engineers Benefit Association. The 54th annual meeting will be held in Washington, D. C., Feb. 11-16, at the Hotel Hamilton.

Engineers' Club of St. Louis. Meeting Feb. 13, 1929. Subject: "Steam Storage and Steam Distribution," by R. A. Longworthy, vice-president and general manager of Ruths Accumulator Company.

Obituary

GEORGE W. BIGELOW, a descendant of Rev. James Pierpont, one of the founders of Yale College, died last night in his ninety-seventh year. He was associated with the Bigelow Boiler Company for more than fifty years.

He distinguished himself in the engineering field and designed and built one of the first reversible engines used in United States submarine torpedo boats. For thirty years he had engaged in the arrangement of a thirteen-month calendar of 28 days each, which was recently submitted to the Washington Patent Office. He was active in the construction of the first railroad in Minnesota.

F. W. MEEGAN, president of the Hydraulic Engineering Corporation, of New York City, died on Nov. 25, in his 63rd year. Mr. Meegan had been closely identified with engineering for the last thirty years.

RICHARD A. HALE, consulting engineer of the Essex Company, Lawrence, Mass., and for many years one of the best-known hydraulic engineers in New England, died at his home in Lawrence, Dec. 17, at the age of 75. He was a past-president of the Boston Society of Civil Engineers, an authority on the flow of the Merrimac River, and was keenly interested in hydro-electric development.

EDWARD R. WELLES, president of the Public Industrials Corporation, New York City, and consulting mechanical engineer to the J. G. White Engineering Corporation, died Dec. 15 at his home in Brooklyn, N. Y., after a brief illness. Mr. Welles graduated from Stevens Institute of Technology in 1900 and immediately formed an association with the J. G. White Engineering Corporation, which he maintained continuously as a consulting expert, as chief mechanical engineer, and in various other executive capacities. In the course of his career he had been consultant to the electric power division of the War Industries Board, particularly in connection with the Muscle Shoals power project; to the Associated Gas & Electric system, and the Central Hudson Gas & Electric Company. Mr. Welles also had professional relations with the Carnegie Steel Company, the New Amsterdam Gas Company, the International Pump Company, and other industrial undertakings. He was 50 years of age at the time of his death.

Personals

GRADY A. SMITH, for the last ten years manager of the Benton, Ark., electric-light and water plants, has resigned to devote himself to personal interests in Florida.

J. E. MCDONALD has resigned as sales manager of the Edward Valve & Manufacturing Company of East Chicago, Ind., to become vice-president of the B. Floersheim Company, Inc., piping engineers and contractors, of Pittsburgh, Pa. He assumes his new duties on Jan. 1.

GEORGE F. HUMPHREY, formerly electrical engineer for the West Penn Power Company, has been appointed chief engineer of the Potomac Edison Company and its subsidiaries.

D. L. KOONTZ announces the opening of an engineering office, specializing in steam plant design, auxiliary power equipment, industrial design and special investigation and engineering reports. The office will be at 176 West Adams St., Chicago, Ill.

OWEN D. YOUNG, chairman of the board of the General Electric Company, and of the Radio Corporation of America, was appointed a trustee of Teachers' College of Columbia University recently.

H. M. SWINDLER, formerly connected with the Riley Stoker Corporation, and recently with the Dayton Stoker Company in charge of engineering and sales, is now connected with the Brownell Company, Dayton, Ohio, in the stoker sales and engineering division.

WILLIAM W. TEFFT, who has been chief engineer of the Commonwealth Power Corporation for the last five years, has resigned to devote his entire time to his consulting engineering practice. He continues his residence and official headquarters in Jackson, Michigan, where he has resided for many years.

J. L. TILDSLEY, JR., formerly with the American Cyanamid Company, is now identified with the Tar Products Division of International Combustion Tar & Chemical Corporation, 200 Madison Ave., New York City.

BUSINESS NOTES

THE OTIS ENGINE CORPORATION, Brooklyn, N. Y., announces that Maj. George T. Sinks is entering the organization in the capacity of vice-president and sales manager.

THE TIMKEN ROLLER BEARING COMPANY has established two new permanent offices, in the Pacific Coast territory, one in Los Angeles, Calif., and one in Seattle, Wash. The former will be in charge of Roy Cross, with address at 1361 South Figueroa St., Los Angeles, and the latter in charge of Marshall Cooledge, at 321 East Pine St., Seattle.

THE GRUENDLER PATENT CRUSHER AND PULVERIZER COMPANY, of St. Louis, Mo., announce that it has recently moved into a new plant in that city, embracing a complete layout of the most modern manufacturing equipment.

THE R. D. NUTTALL COMPANY, Pittsburgh, Pa., has appointed H. A. Houston as works manager. Mr. Houston comes from an executive capacity in the Westinghouse Electric & Manufacturing Company, of which the Nuttall Company is a subsidiary.

THE ELECTRO-NITE CARBON COMPANY, Philadelphia, Pa., announces that its Pittsburgh office is now in charge of Robert Graf and is located at 18 Market Street, Pittsburgh.

THE GRISCOM-RUSSELL COMPANY announces that its office in Boston is now in the Chamber of Commerce Building, 80 Federal Street.

THE HISEY-WOLF MACHINE COMPANY, of Cincinnati, Ohio, announces that it has just opened an office in Chicago, which will be in charge of Roy D. Haworth. The office will be at 210 Machinery Hall, 549 West Washington Blvd., Chicago, Ill.

THE COMBUSTION CORPORATION OF AMERICA, through its president, H. D. Savage, announces the election of Carl F. Weigel as vice-president and general manager of a subsidiary, the Hedges-Walsh-Weidner Company, Chattanooga, Tenn. Prior to the combination of the Walsh & Weidner Boiler Company and the Casey-Hedges Company, which occurred the early part of this year, Mr. Weigel was chief engineer of the Walsh & Weidner Boiler Company, which position he had occupied for many years.

Coming Conventions

American Boiler Manufacturers Association, mid winter meeting, Cleveland, Ohio, Feb. 5, 1929. A. C. Baker, secretary, 801 Rockefeller Bldg., Cleveland, Ohio.

American Institute of Electrical Engineers, annual winter convention, New York City, Jan. 28-Feb. 1; annual summer convention, Swampscott, Mass., June 24-28; F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Institute of Refrigeration, at Washington, May, 1929. Louis Baron, secretary, 203 West 13th St., New York City.

American Oil Burner Association, annual convention, Hotel Pennsylvania, New York City, April 9-11, 1929. For information, address the headquarters of the Association at 420 Madison Ave., New York City.

American Society of Heating and Ventilating Engineers, 35th annual meeting, Chicago, Ill., Jan. 28-31, 1929. A. V. Hutchinson, secretary, 29 West 39th St., New York City.

American Society of Mechanical Engineers, spring meeting, Salt Lake City, Utah, July 1-4, 1929. Calvin Rice, secretary, 29 West 39th St., New York City.

Association of Iron and Steel Electrical Engineers, 25th annual convention, Pittsburgh, Pa., June 17-22, 1929. A. A. Stewart, secretary, Pittsburgh Steel Co., Monnessen, Pa.

Engineering Institute of Canada, annual general and professional meeting, at Hamilton, Ont., Feb. 13-15, 1929. R. J. Durley, secretary, 2050 Mansfield St., Montreal, Que.

Master Boiler Makers Association, at Atlanta, Ga., May 21-24. H. D. Vought, secretary, 26 Cortlandt St., New York City.

Midwest Power Conference and Exhibition, at Chicago, Feb. 12-16; Conference headquarters at the Palmer House, Exhibition at the Coliseum; G. E. Pfisterer, secretary 53 West Jackson Blvd., Chicago.

World Engineering Conference, Tokyo, Japan, October, 1929. All correspondence should be addressed to the Secretary, World Engineering Conference, Nikon, Kogyo Club, Morunouchi, Tokyo.

TRADE CATALOGS

ELECTRIC EQUIPMENT FOR THE PETROLEUM INDUSTRY—Under this title the General Electric Company, Schenectady, N. Y., has issued Bulletin No. GEA-922, giving a complete picture of the application of electrical machinery to the oil industry. The bulletin is well illustrated, and of a somewhat general nature.

GENERATORS — Horizontal generators for waterwheel drive is the subject of the four-page leaflet 3556C issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. There are illustrations of stators and rotors, as well as of several installations.

SQUIRREL-CAGE MOTORS — A four-page bulletin GEA-81B, published by the General Electric Company, Schenectady, N. Y., illustrates and explains a new line of high-torque double squirrel-cage motors. It gives, also, a table of mechanical dimensions and typical torque and current curves.

SPEED REDUCERS—The Morrison Machine Company of Paterson, N. J., has just issued an attractive 22-page booklet on its speed-reducing transmissions, with illustrations, plans of fourteen different models, and the horsepower ratings for each.

ROPE DRIVES—Bulletin No. 1228-H is a fifteen-page booklet issued by the Allis-Chalmers Manufacturing Company, of Milwaukee, Wis., principally filled with illustrations showing Texrope Drives in different applications.

STEAM PURIFIERS—In an attractive eight-page catalog the Marley Company (formerly the Power Plant Equipment Company), of Kansas City, Mo., describes the Marley steam purifier of horizontal and vertical types and comments on methods of draining the purifier, either by settling drum or steam trap.

FUEL PRICES

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.35@$2.40
Kanawha	Columbus	1.25@1.45
Smokeless	Cincinnati	2.25
Smokeless	Chicago	2.25
S. E. Kentucky	Chicago	1.35@1.60
Steam	Pittsburgh	1.60@1.70
Gas Slack	Pittsburgh	.75@.90
Big Seam	Birmingham	1.25@1.50
Anthracite (Gross Tons)		
Buckwheat	New York	$2.75@$3.25
Barley	New York	1.25@1.75

FUEL OIL

New York—Dec. 27, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4⅜c. per gal.; 36@40 deg., furnace, tank-car lots, 6½c. per gal.

St. Louis — Dec. 18, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.37½ per bbl. or 42 gal.; 26@28 deg., $1.42½ per bbl.; 28@30 deg., $1.47½ per bbl.; 30@32 deg., $1.52½ per bbl.; 32&36 deg., gas oil, 4.3c. per gal.; 38@40 deg., 5.4c.

Pittsburgh—Dec. 14, f.o.b. local refinery, 30@34 deg., fuel oil, 5c. per gal.; 36@40 deg., 5½c. per gal.

Philadelphia—Dec. 23, 13@19 deg., $0.95@$1.02 per bbl. or 42 gal.; 22 deg. plus, $1.47@$1.53 per bbl.; 26@30 deg., $2.00@$2.06 per bbl.

Cincinnati — Dec. 17, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5½c. per gal.; 30@32 deg., 5.95c. per gal.

Chicago—Dec. 15, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 65c. per bbl.; 26@30 deg., 72½c. per bbl.; 30@32 deg., 97½c.@$1 per bbl.

Boston—Dec. 17, tank-car lots, f.o.b. 12@32 deg. Baumé, 4½c. per gal.; 28@32 deg., 5.6c. per gal.

Dallas—Dec. 22, f.o.b. local refinery, 26@30 deg., $1.20 per bbl. or 42 gallons.

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Sacramento—Champion Sillimanite Co. Inc. has been granted permit for appropriating 2.5 second ft. of water from Milner Creek in Merced county to develop 250 hp. for power purposes. Estimated cost $46,000.

Ill., Champaign—Holabird & Root, 333 North Michigan Ave., Chicago, Archts., will receive bids about Jan. 25, for the construction of an ice skating rink at 5th and Armory Sts. here, for State of Illinois Athletic Assn. Estimated cost $300,000.

Ill., Chicago—Commonwealth Edison Co., 72 West Adams St., awarded contract for a 57 x 81 ft. sub-station. Estimated cost $27,000.

Ill., Chicago—Little Company of Mary, 4130 Indiana Ave., is having plans prepared for the construction of first unit of hospital, 5 story, including power plant, at 93rd St. and California Ave. Estimated cost $1,000,000. Total estimated cost $6,000,000. J. W. McCarthy, 139 North Clark St., is architect.

Ill., Chicago—Holabird & Root, 333 North Michigan Ave., Archts., will receive bids until Jan. 7 for the construction of an 8 story stores and office building at Grand, Ohio, Rush Sts. and Michigan Ave., for W. H. McChesney, 30 N. La Salle St. Estimated cost $2,000,000.

Ill., Highland Park—Village awarded contract for a water filtration plant and pumping station to Priester Construction Co., Koh! Bldg., Davenport, Ia. Estimated cost $300,000.

Ill., Oak Park—J. E. Decker, 508 Fair Oaks Ave., will build a 10 story apartment building, including steam heating system, etc., on Wisconsin Ave. Estimated cost $1,000,000. Work will be done by separate contracts under the supervision of Leichenko & Esser, 38 South Dearborn St., Chicago, Archts.

Ia., Clarion—Municipal Utilities Co., Des Moines, plans the construction of a light plant here. Estimated cost $100,000.

Mass., Boston — United Shoe Machinery Corp., 205 Lincoln St., awarded contract for the construction of a 24 story office building at 138-162 Federal St. to G. A. Fuller Co., 11 Beacon St., Boston.

Mo., St. Louis—Alco Investment Co., V. A. Chinberg, 808 Chestnut St., is having preliminary plans prepared for a 17 story apartment building, including steam heating system, etc., at Lindell St. and Euclid Ave. Estimated cost $2,000,000. Nolte & Naumann, 614 Fullerton Bldg., are architects.

N. J., Elizabeth — Dry Ice Corp. of America, plans addition to ice plant at 1001 Newark Ave. Estimated cost $40,000. Private plans.

N. J., Jersey City — Journal Sq. Hotel Corp., W. C. Heppenheimer, Chn., 369 Lexington Ave., New York, N. Y., is having preliminary plans prepared for a 17 story hotel, including steam heating and ventilation systems, boilers, pumps, elevators, etc., at 2859-71 Hudson Blvd. Estimated cost $5,000,000. Thomas, Martin & Kilpatrick, 220 South 16th St., Philadelphia, are architects and engineers.

N. J., Montville—Jersey Centre Power & Light Co., 20 South St., Asbury Park, plans the construction of a gas generating and storage plant, here. Estimated cost $40,000. Engineer not selected.

N. J., Newark — L. & K. Ice Corp., awarded contract for the construction of an ice plant at 250-270 Badger Ave., to A. C. Windsor, 717 Broadway, New York. Estimated cost $40,000.

N. J., Ridgewood — North Oak Improvement Co., F. A. Tetor, 243 West Ridgewood Ave., will soon award contract for the construction of a 4 story theatre, stores and apartment buildings including steam heating system, etc. at Franklin Ave. and North Oak St. Estimated cost $1,000,000. P. A. Vivarttas, 110 48th St., Union City, is architect.

N. J., Sayreville — Eastern New Jersey Power Co., Main St., plans the construction of an electric generating plant. 60,000 kw. capacity. Estimated cost $6,000,000.

N. Y., Yonkers—Owner, c/o J. Watson, 29 Amackassin Pl., Engr. is having preliminary sketches made for the construction of a cold storage plant. Estimated cost $200,000.

O., Dayton—Leland Electric Co., North St. Clair St., will soon award contract for addition to boiler room and plant. Estimated cost $200,000. Ballinger Co., 105 South 12th St., Philadelphia, Pa., is engineer.

O., Toledo—Toledo Ice & Coal Co., J. M. Murphy, Pres., 2130 Jefferson Ave., is having plans prepared for the construction of an ice plant on Woodruff St. Estimated cost $200,000. Alfred-Hahn, Close Realty Bldg., are engineers.

O., Weston—City will receive bids until Feb. 1, for the construction of waterworks and distribution systems including pump house, etc. Estimated cost $45,000. G. Champe, Security Bank Bldg., is engineer.

O., Woodville—City is having plans prepared for waterworks improvements, including pumping station, etc. Estimated cost $55,000. G. Champe, Security Bank Bldg., are engineers.

Ore., Portland—Portland Electric Power Co., 329 Alder St., budget for 1930 includes $2,000,000 for new construction work.

Tex., Baytown—American Service Co., B. R. Wood, will build a 20 ton ice plant. Estimated cost $32,000. Private plans.

Tex., Brownsville—R. H. Hill and J. D. Morton, Itasca, will build an 18 ton ice plant here. Estimated cost $25,000. Private plans.

B. C., Victoria—British Columbia Electric Ry. Co. Ltd., is having plans prepared for the construction of a new 15,000 hp. unit at Jordan River power station, also transmission lines, etc. Estimated cost $1,800,000. G. M. Tripp, c/o owner, is engineer.

Ont., Toronto — Wellington Building Corp., 84 Hilton Ave., awarded general contract for an 11 story office and loft building on Wellington St. to Lumsden Engineering & Transport Co., Lumsden Bldg. Steam heating and ventilation systems, elevators, etc. will be installed.

Equipment Wanted

Engine—F. Young, Osage City, Mo., is in the market for a 4 cylinder, 4 cycle gas engine.

Engine, Pump, Etc. — Amory Concrete & Gravel Co., Amory, Miss., is in the market for a 70 to 80 hp. natural gas engine, 800 r.p.m., also 6 in. manganese fitted gravel pump.

Generator and Turbine—City, F. G. Godfrey, New Bern, N. C., plans the installation of a new generator and turbine for proposed extension to water and light plant.

Generator Sets, etc.—Bureau of Yards & Docks, Navy Dept., Washington, D. C., will receive bids until Jan. 23 for motor generator sets and equipment at Puget Sound, Wash., New York, N. Y., and South Boston, Mass.

Pumps—Bureau of Supplies & Accounts, Navy Dept., Washington, D. C., will receive bids until Jan. 8 for six fresh water centrifugal pumps and spares at San Francisco, Calif., New York, N. Y., and Seattle, Wash.

Pumps, etc. — California Hot Springs County, Visalia, Calif., will receive bids until Jan. 23 for pumps, etc., for proposed sewage treatment plant.

Pumps, Etc.—City of Reading, Pa., will receive bids until Jan. 16, for furnishing and installing three 9 m.g.d. motor operated horizontal centrifugal pumps, switchboard, automatic control mechanism, etc. for proposed reconstruction of pumping station.

Refrigeration Equipment — International Ice & Cold Storage Co., 905 Mercer St., Windsor, Ont., plans the installation of refrigeration equipment in proposed warehouse. Estimated cost $1,000,000.

Industrial Projects

Ark., Pine Bluff—AUTOMOBILE BODY PLANT ADDITION — Seaman-Dunning Corp., awarded contract for a 1 story, 218 x 280 ft. addition to plant to E. C. Royce, Pine Bluff.

Ill., Chicago—MOTOR SHUTTER FACTORY—Pines Winterfront Co., F. Raleigh, Pres., 408 North Sacramento Blvd., plans the construction of a 2 story factory for the manufacture of winterfronts for automobiles. Estimated cost $1,000,000. Architect not selected.

Ind., East Chicago—FOUNDRY—American Steel Foundry Co., 410 North Michigan Ave., Chicago, Ill., awarded contract for a 1 story, 75 x 100 ft. foundry here, to Sumner-Sollitt, 307 North Michigan Ave., Chicago, Ill. Estimated cost $40,000.

Mich., Detroit — TRUCK FACTORY — Federal Motor Truck Co., 5780 Federal Ave., will soon award contract for a 2 story 60 x 400 ft. truck factory. Estimated cost $250,000. F. J. Winter, 2112 Book Tower, is architect. Owner is in the market for steam heating system, electric motors and truck assembly equipment.

Mich., Detroit — AUTOMOBILE PARTS FACTORY — Timken Detroit Axle Co., Clark St., awarded contract for a 2 story factory on Clark St. to C. O. Barton Co., 1900 East Jefferson Ave. Estimated cost $50,000. Steam heating and miscellaneous machine shop equipment will be installed.

Mich., Detroit — CARBURETOR FACTORY — Zenith Detroit Corp., ft. of Hart Ave., is having plans prepared for a 2 story, 60 x 120 ft. factory on Lycaste Ave. Estimated cost $50,000. Donaldson & Meier, 1188 First National Bldg., are architects.

Mich., St. Joseph — BOAT BUILDING PLANT — Robinson Marine Construction Co., 227 West Main St., Benton Harbor, awarded contract for a 1 story, 50 x 60, 50 x 100 and 50 x 180 ft. plant here, to M. W. Stock Construction Co., Broad St., St. Joseph. Estimated cost $60,000.

Minn., Minneapolis—FURNITURE FACTORY—Grau-Curtis Co., 613 First Ave. N. E., is having plans prepared for the construction of a 2 story, 137 x 144 ft. factory on First Ave. N. E. Estimated cost $100,000. Lang, Raugland & Lewis, 412 Essex Bldg., are architects.

Mo., St. Louis—TRUCK BODY PLANT—Owner, c/o I. T. Cook Co., Arcade Bldg., is having plans prepared for a 1 story, 160 x 200 ft. truck body plant at Forest Park Blvd. and Sarah St. Estimated cost $80,000. P. J. Bradshaw, 718 Locust St., is architect. St. Louis Body & Equipment Co. is lessee.

N. Y., Hastings-on-Hudson—PLANT—Hastings Pavement Co. awarded contract for the construction of a manufacturing plant including 50 x 50 ft. boiler plant, etc., to replace fire loss to L. F. Caproni & Co., 1056 Chapel St., New Haven, Conn.

Pa., Pittsburgh — PIG IRON and CEMENT PLANT — Davison Coke & Iron Co., Oliver Bldg., awarded contract for the construction of a group of buildings for pig iron and cement plant at Neville Island to Rust Engineering Co., American State Bldg. Estimated cost $1,500,000.

Pa., Wilkinsburg — CHROMIUM FACTORY — U. S. Chromium Corp., of Pittsburgh, awarded contract for a 1 story, 72 x 100 ft. factory at Pitt and Wallace Sts. to Lambert & Youngh, 1010 Center Ave. Estimated cost $40,000.

West Virginia—MACHINE SHOPS, ETC. —Chesapeake & Ohio R.R., Baltimore, Md., plans to expend $3,500,000 for new locomotive repair shops, machine shops, etc., at Huntington, also $3,100,000 for new car repair shops at Russell. C. W. Johns, Richmond, is chief engineer.

Ont., Weston — BUILDING PRODUCTS FACTORY — Arco Co. Ltd., 16 Liberty St., Toronto, awarded contract for the construction of a 4 story, 50 x 70 ft. factory here, to Wells & Gray, Confederation Life Bldg., Toronto. Estimated cost $150,000.